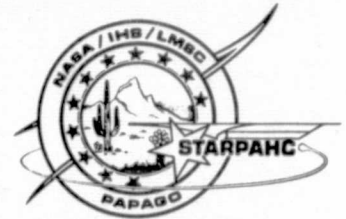


General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.



NASA CR-

151432

LMSC-D508255
15 JANUARY 1977

STARPAHC THIRD INTERIM OPERATIONAL REPORT

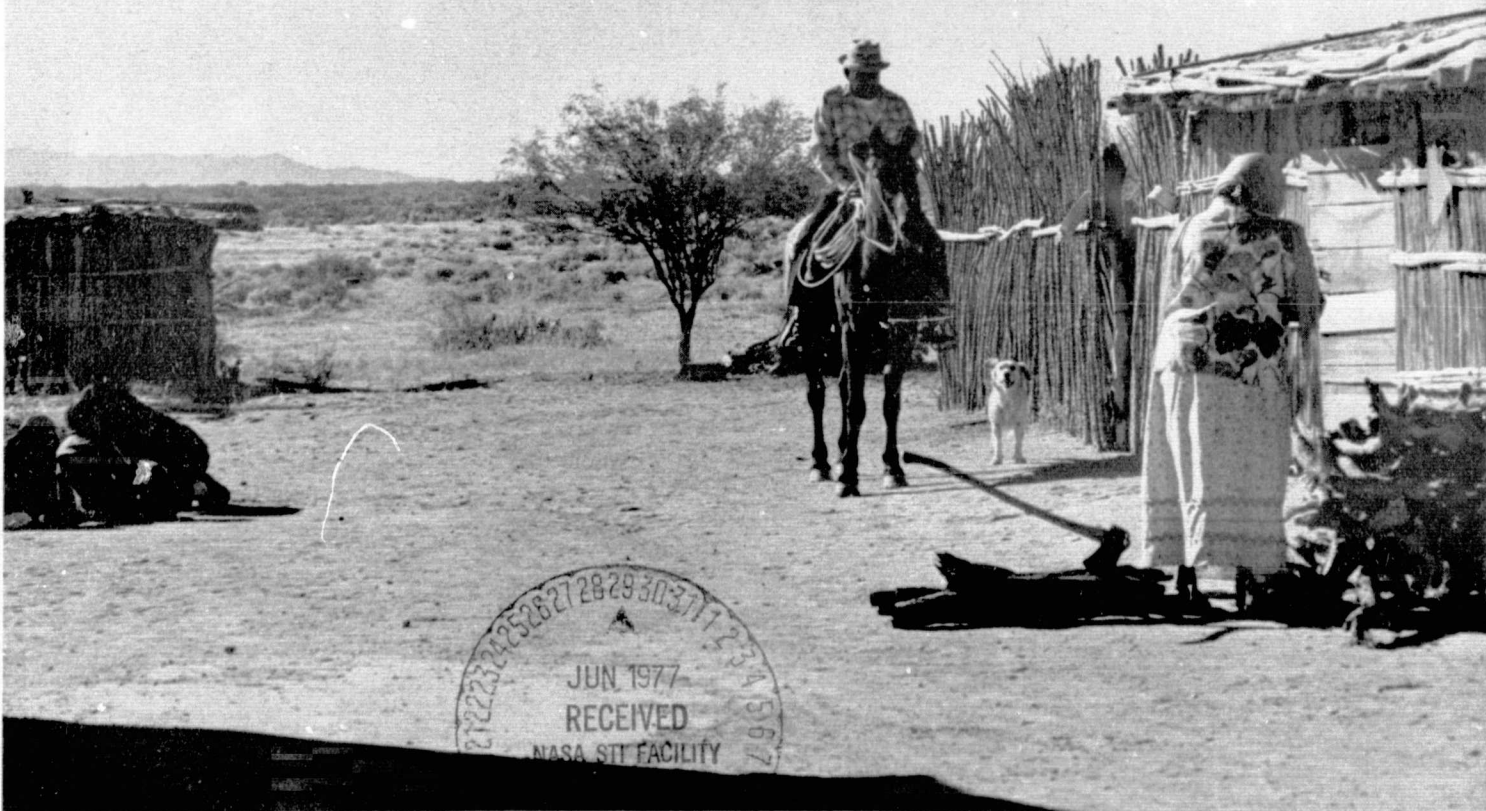
Period: May 1975 Through October 1976

(NASA-CR-151432) STARPAHC OPERATIONAL
REPORT Interim Report, May 1975 - Oct. 1976
(Lockheed Missiles and Space Co.) 149 p
HC A07/MF A01

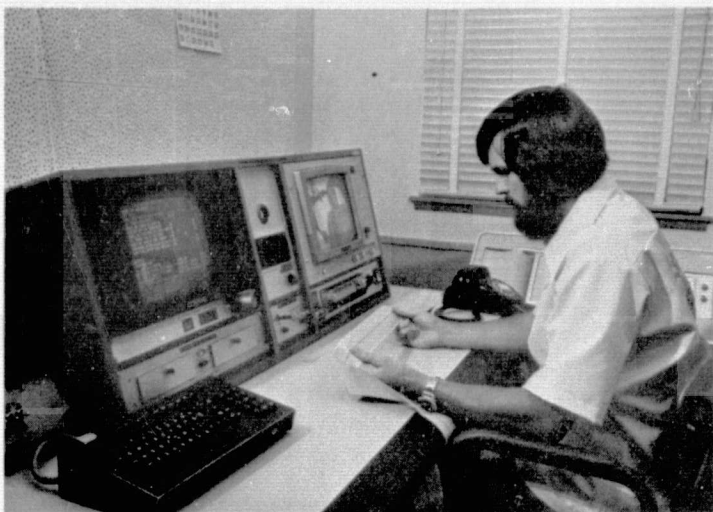
N77-26794

CSSL 06E

G3/52 Unclass
31765



LOCKHEED MISSILES & SPACE COMPANY, INC.
A SUBSIDIARY OF LOCKHEED AIRCRAFT CORPORATION



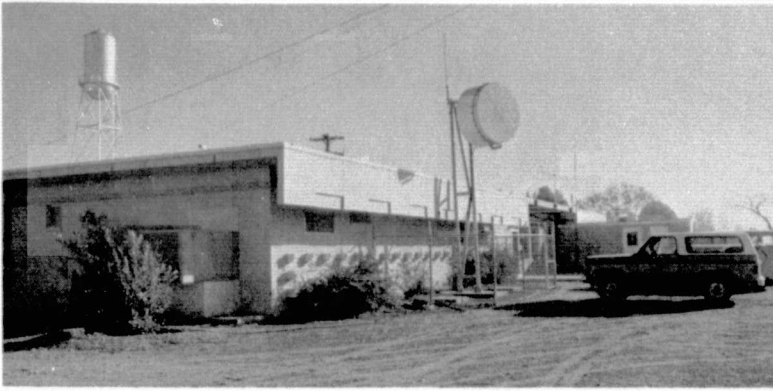
1A PHYSICIAN'S CONSOLE IN THE HSSCC



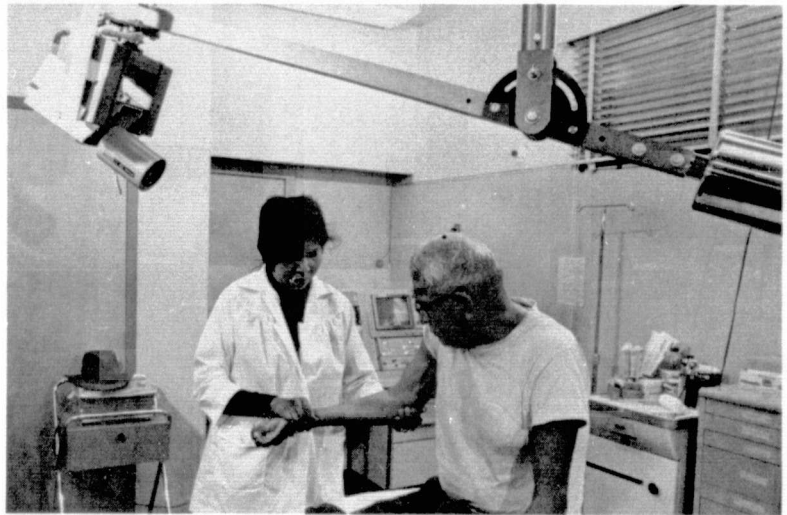
2A HEALTH SERVICES SUPPORT CONTROL CENTER (HSSCC) WITH SELLS HOSPITAL



3A SYSTEM OPERATOR'S CONSOLE IN THE HSSCC



18 HEALTH CENTER AT SANTA ROSA



28 SANTA ROSA EXAMINATION ROOM



38 SANTA ROSA TV MICROSCOPY LABORATORY



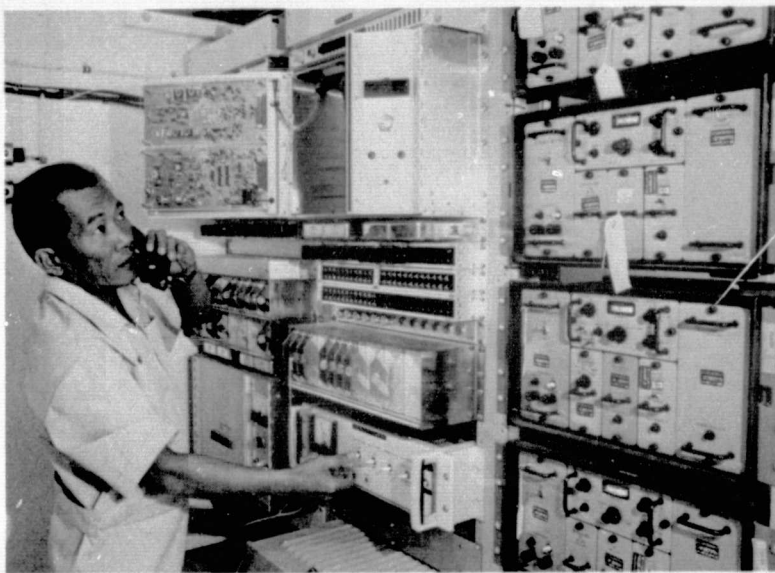
1C MOBILE HEALTH UNIT AT VILLAGE STOP



2C MHU EXAMINATION ROOM



3C MHU LABORATORY



1D QUIJOTOA - INTERIOR OF RELAY SHACK, MICROWAVE EQUIPMENT



2D QUIJOTOA RELAY CENTER SHOWING
PRIMARY WIND-DRIVEN GENERATOR
POWER SUPPLY



1E PHOENIX INDIAN MEDICAL CENTER



2E SLO-SCAN TELEVISION CONSOLE, PHOENIX

E



STARPAHC THIRD INTERIM OPERATIONAL REPORT

Period: May 1975 Through October 1976



15 January 1977

FOREWORD

Lockheed Missiles & Space Company, Inc. (LMSC) submits this STARPAHC Third Interim Operational Report in compliance with Contract NAS 9-13170 dated 15 December 1972, covering evaluation of one and one-half years of on-site operations.

This program for Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) is being conducted under the auspices of the NASA (Johnson Space Center), Norman Belasco, Project Officer, working in conjunction with DHEW (IHS-ORD), Stuart Rabeau, M.D., Director, and the Papago Indian Nation, Cecil Williams, Chairman of the Tribal Council, and the Executive Health Staff of the Papago Tribe. The LMSC STARPAHC team is under the direction of James M. Smith, Program Manager, assisted by F. E. Riley.

The STARPAHC system (description in Appendix B) is being evaluated over a 2-year operational period. Evaluation of the medical aspect is being conducted by IHS under the direction of James W. Justice, M.D., and evaluation of the hardware aspect is being conducted by LMSC. At the completion of the 2-year period, the results of these evaluations will be synthesized into a final systems report.

This report summarizes the results of the first one and one-half years of operation. An operational cost summary analysis also is presented.

GLOSSARY OF ABBREVIATIONS

A/N CRT	Alpha/Numeric Cathode Ray Tube
APU	Auxiliary Power Unit
B&W	Black and White
baud	Unit of Signaling Speed
BIA	Bureau of Indian Affairs
CHR	Community Health Representative
CHM	Community Health Medic
CRT	Cathode Ray Tube
CPU	Central Processing Unit
DHEW	Department of Health, Education, and Welfare
ECG	Electrocardiogram
FCC	Federal Communications Commission
FD or FDX	Full Duplex
HIS	Health Information System
HRA	Health Resources Administration
HSA	Health Services Administration
HSSCC	Health Services Support Control Center
Hz	Hertz (cycles per second)
I.D.	Identification - LMSC Employee Number or IHS Medical Record Number
IHS	Indian Health Service
IMBLMS	Integrated Medical and Behavioral Laboratory Measurement System
I/O	Input/Output Terminals
IPO	IMBLMS Program Office
JSC	Johnson Space Center
KVA	Kilovolt-Amperes
LHSC	Local Health Services Center
LMSC	Lockheed Missiles & Space Co., Inc.
LPN	Licensed Vocational Nurse
MHU	Mobile Health Unit

GLOSSARY OF ABBREVIATIONS
(Continued)

MHW	Mental Health Worker
MHz	Megahertz (million cycles per second)
MUX	Audio Multiplexer Unit
NASA	National Aeronautics and Space Administration
NASA-MEDICS	NASA Medical Information Computer System
OPD	Outpatient Department
PAM	Portable Ambulance Module (Telecare Unit manufactured by SCI Electronics, Houston, Texas)
PAR	Performance Acceptability Ratio
	Gross PAR = $(1 - \frac{\text{Failures}}{\text{Telecommunications}}) \times 100 = \%$
	Net PAR = $(1 - \frac{\text{Anomalies (Fair, Poor, Failures)}}{\text{Telecommunications}}) \times 100 = \%$
PHN	Public Health Nurse
PHS	Public Health Service
PIMC	Phoenix Indian Medical Center
PRC	Phoenix Referral Center (STARPAHC terminal equipment located in Phoenix Indian Medical Center)
QRS	Quijotoa Relay Station
R&DD	Research and Development Division (of IMSC)
rf	Radio Frequency
STARPAHC	Space Technology Applied to Rural Papago Advanced Health Care
TCE	Telecommunication Equipment
TTY	Teletypewriter
UPS	Uninterruptible Power System
vhf	Very High Frequency (STARPAHC 170-MHz Band)
VTR	Video Tape Recorder
WDG	Wind-Driven Generator

GLOSSARY OF COMPUTER TERMS

ACMED	A MEDICS application program whose function is to provide reports of medications due for inpatients in the Sells Hospital. This program uses the Active Medications Data Base, and is used primarily by the Nurses at the Nurses Station.
ACTIVE MEDICATIONS DATA BASE	This data base is a collection of data regarding the medications ordered by the attending physician for inpatients at the Sells Hospital. In general, this data includes hours due, medication, dosage, physician's name, patient name, and room number. This data base is primarily used by the ACMED and MEDS programs.
BSC	Binary Synchronous Communication. The Data Concentrator uses this discipline when transferring data from the Indian Health Service Computer in Tucson.
CDI HARDCOPY	This is the terminal that communicates with the computer. There is a keyboard where alphabetical or numeric characters can be sent to the computer. Messages from the computer are typed out on paper (hard copy). CDI is the name of the vendor.
DATA BASES	An organized collection of data. Organization of each data base is directly related to the data to be stored; i.e., numeric data is filed in numeric order, time related data is filed chronologically, or alphabetic data such as patient names, is filed alphabetically. The MEDICS data bases can be accessed by several application programs. Users use these programs to store, report, or change data in the data bases.
DATA CONCENTRATOR	The Data Concentrator is a software program that compacts data to be sent to the Indian Health Service Computer in Tucson. Another function of the Data Concentrator is to unpack compacted data from the computer in Tucson and transfer it to the terminal. The program also maintains the BSC line discipline for the outgoing and incoming messages.
DIAL-UPS	Four telephone lines are available to the user to dial the STARPAHC computer for access of data. The user can dial the computer and place the telephone headset into his terminal. He then can request patient summaries from the Tucson computer or any of the data bases maintained in the STARPAHC computer.
DISEASE LIBRARY	This data base is a collection of reports used by the paramedics and nurses. The Guidelines of Care reports are used by the paramedics to guide them in diagnosing diseases. The Nurses Standards reports are used by the nurses to remind them of tasks needed to be accomplished in their care of the patient. These reports are filed by Disease Name.

GLOSSARY (Cont'd)

EQUIPMENT RECORDS DATA BASE	This data base is used to collect data regarding the STARPAHC equipment. Preventive maintenance schedules and procedures along with Trouble Reports and Usage Reports are maintained in this data base.
FOLLOW-UP CLERK TEC CRT	This terminal resides in the Follow-Up Clerk's office at Sells Hospital. The main function of this terminal is to schedule outpatients for the Specialty Clinics. The terminal is a CRT (TV set) with a keyboard for sending alphabetic or numeric characters to the computer. Messages from the computer are flashed on the TV screen (CRT). TEC is the vendor name.
GE HARDCOPY	This terminal is used to communicate with the computer. It has a keyboard for sending alphabetical and numerical data to the computer. The computer types out messages on paper (hard copy).
GUIDE	This is a MEDICS application program that types out the Guidelines of Care reports to the user. These reports are used by the paramedics to guide them in diagnosing diseases. There are five reports available now. All reports are designed by the Indian Health Service.
HAZELTINE CRT	This is the terminal located at the Nurse's Station. This terminal is used for accessing the Active Medications reports and the Nurse's Standards. This terminal has a CRT (TV screen) and a keyboard for sending alphabetical or numerical characters to the computer. The computer flashes messages on the CRT screen. Hazeltine is the vendor name.
HIS	Health Information System. This is the name of the computer in Tucson that maintains the Indian Health Service patient summaries.
IMS	This is a MEDICS application program that summaries patient exam data. This program utilizes the Outpatient Records data bases.
INFOTON	This is a terminal with a CRT (TV screen) and a keyboard for sending alphabetic and numeric data to the computer. The computer sends messages to the CRT screen. There is an Infoton (vendor name) in the LHSC as well as the Pharmacy.
INPATIENT RECORDS DATA BASE	This data base is a collection of hospital census information, such as admissions, discharges, and disposition in case of fatality.
INPUTP	This is a MEDICS application program used in storing data into any one of the various data bases. The program uses a question/answer technique where the questions are related to the data base and the answers are typed in (by keyboard) by the user and stored by the program.

GLOSSARY (Cont'd)

MEDS	This MEDICS application program is used to store data exclusively into the Active Medications Data Base. The program is identical to the INPUTP program in structure, but differs in the amount of data stored. Upon completion of a question/answer session, the program interrogates the answers to store multiple data into the data base. If a user stores for ten days, a certain hour that a patient is to receive medication, ten sets of the data are stored - one for each day at the given hour.
MEDICS APPLICATION PROGRAMS	These are programs that are designed to interact with a user at his terminal. They store, manipulate, or report data from the data bases to the user or from the user to the data bases. These programs constitute a major portion of the computer usage.
NURSE	This MEDICS application program is used to report Nurses Standards to a terminal. The program utilizes the Disease Library Data Base.
OUTPATIENT RECORDS DATA BASE	This data base is a collection of patient exam data such as blood pressure, pulse, temperature, weight. This data base is used primarily by the IMS program.
PHARMACY DATA BASE	This data base is a collection of patient data regarding medications for outpatients. This data base is used primarily by the Pharmacy at Sells Hospital.
PHY/OPS TEC CRT	This is a terminal that communicates with the computer. There is a keyboard for sending alphabetical or numerical characters. The computer flashes messages on the CRT (TV screen). TEC is the vendor name. This terminal is located at the Physician's Console and the Operator's Console.
RETRVL	This MEDICS application program reports data to the user at the terminal. The user can request tabulations, lists, etc., to define the report. Any data base can be used by this program.
SCHEDULE DATA BASE	This data base is a collection of patient data regarding scheduling patients for the specialty clinics. This data base is primarily used by the Schedule program.
SCHEDULE	This MEDICS application program generates schedules based on data found in the Schedule Data Base. The user can request a schedule for any clinic in the system and for any day.
STAT3	This software program provides daily statistics of the computer usage giving user name, program(s) used, data base used, etc. This program reports these statistics at 5:00 each afternoon.

GLOSSARY (Cont'd)

STAT4	This software program summarizes the total daily statistics contained in the computer file. This program is usually executed weekly, summarizing the week's computer usage. Data reported is the same as STAT3.
STATS	This MEDICS application program reports statistical data to the terminal; it provides the number of users in the system and the terminals being used. This program is available to the user at the terminal.
TERMINALS	These are devices especially designed to communicate with the computer. A terminal can be a CRT (TV screen) or hard copy (paper) and always has a keyboard for sending alphabetic or numeric characters to the computer. Using a terminal, a user can store data, retrieve a report of data on the computer, or change data in the computer.
TESPAT	This MEDICS application program types a test pattern onto the screen (in the case of CRT's) or on paper (in the case of hard copy). This program is used for check-out purposes only.
TI HARDCOPY	This terminal resides in the MHU Reception area and is used to access data from the Indian Health Service computer in Tucson as well as the STARPAHC computer. Alphabetic or numeric characters are sent to the computer using a keyboard. Messages from the computer are typed out on paper (hard copy). TI is the vendor name.
UPDATE	This MEDICS application program allows a user at the terminal to change or delete any data in any of the data bases.
USERS	This term defines the person(s) who access the computer system. To access any data in the system, a user must tell the computer his access code, by typing the access code on his keyboard. This access code is used to define who the user is and the data bases he may access.

CONTENTS

<u>Section</u>		<u>Page</u>
	FOREWORD	ii
	GLOSSARY	iii
	ILLUSTRATIONS AND TABLES	x
1	SUMMARY	1-1
2	MEDICAL EVALUATION RESULTS	2-1
	2.1 Summary of Findings in Patterns of Health Care Changes	2-2
	2.2 Utilization of Health Services Before and After STARPAHC Operation	2-4
	2.3 Medical Utilization of STAPRHAC Equipped Facilities and Telecommunications	2-19
	2.4 Perceived Value of Telecommunications	2-23
	2.5 Failure Ratios for Consultations	2-24
	2.6 Evaluation of Slow Scan Television	2-26
3	SYSTEM USAGE	3-1
	3.1 Hardware Evaluation Approach	3-1
	3.2 Telecommunications Equipment (TCE) Usage	3-3
	3.3 QRS Usage	3-6
	3.4 MHU Usage	3-6
	3.5 Computer and Peripheral Equipment Usage	3-7
	3.6 Computer Software/Terminal Usage	3-7
	3.7 Power Equipment Usage	3-9
4	HARDWARE EVALUATION RESULTS	4-1
	4.1 Utilization and Performance of System Equipment	4-1
	4.2 Reliability Evaluation	4-17
5	COST ANALYSIS	5-1
	5.1 Project STARPAHC Costs	5-1
	5.2 Recurring Costs of Project STARPAHC Operations and Maintenance	5-2
	5.3 Nonrecurring Costs of Acquiring Project STARPAHC Systems	5-6
	5.4 The Nature of STARPAHC Unit Cost Considerations	5-8
	5.5 Cost Per Outpatient Visit to STARPAHC Facilities	5-9
	5.6 Comparison of STARPAHC Costs Between Mobile and Fixed Site Clinics	5-13
Appendix A	Evaluation Plan	A-1
Appendix B	STARPAHC System Description	B-1
Appendix C	Trouble Report Review ix	C-1

TABLES

<u>Table</u>		<u>Page</u>
2-1	Number of Visits and Percent Change to All Ambulatory Health Services (Excluding Dental)	2-7
2-2	Changes in Numbers of Individual Patients Using All Ambulatory Services	2-8
2-3	Ratio of Patients to Patient Ambulatory Care Visits	2-10
2-4	Percent of Population Utilizing Any Ambulatory Health Care Facility	2-11
2-5	Utilization of STARPAHC Equipment for Patient Consultation from the Field Clinics to Sells	2-20
2-6	Patient Consultations Using Television	2-22
2-7	Perceived Value of Teleconsultations by Sender (CHM) and Receiver (MD)*	2-25
2-8	Consultations Summary	2-25
3-1	Telecommunication TCE Usage Box Score	3-4
3-2	Telecommunications Usage Box Score/Month	3-5
4-1	Glossary of Telecommunication Equipment Terms	4-2
4-2	Total Telecommunication/Medical Telecommunication Comparison	4-5
4-3	TCE Usage Box Score/Month	4-6
4-4	TCE Usage Box Score/Month	4-7
4-5	Usage Tabulation/TCE Type	4-9
4-6	Usage Tabulation/TCE Type	4-10
5-1	Recurring Costs of Operations and Maintenance Distribution by Month and by Agency 18 Months of STARPAHC Operations May 1975 - October 1976	5-3
5-2	Nonrecurring Costs Installed Equipment and System Improvements Showing Amortization Rates	5-7
5-3	Cost Per Outpatient Visit	5-10
A-1	Data Logs	A-3
A-2	Teleconsultation Evaluation Forms for Sells Consultants	A-8
A-3	Teleconsultation Evaluation Forms for Santa Rosa Clinic and MHU	A-9

TABLES (continued)

<u>Table</u>		<u>Page</u>
A-4	HIS Monthly Patient Tabulation	A-11
A-5	Health Summary from the Health Information System	A-13
B-1	Mean Waiting and Service Times* Per Patient, Each Day and All Days Mobile Health Unit, Sells Service Unit, March 22-25, 1976	B-11
B-2	Mean Waiting and Service Times* Per Patient Each Day and All Days Mobile Health Unit, Sells Service Unit, July 19-22, 1976	B-12
B-3	Telecommunications About Patients from the Mobile Clinic by Type and Purpose During the Observation Period March 22-25, 1976	B-15
B-4	Telecommunication About Patients From the Mobile Clinic by Type During the Observation Period July 19-22, 1976	B-16
B-5	Patient Visits by Primary Diagnosis to the Mobile Health Unit: March 22-25, July 19-22, 1976	B-19
B-6	Patients Visits, Total and Observed 4 Sites, Indian Health Service	B-22

Section 1

SUMMARY

The primary goals of the STARPAHC Program are to:

- o Provide data for developing health care for future manned spacecraft,
- o Establish the feasibility of the STARPAHC concept for improving the delivery of health care to remote areas on earth.

Accordingly, the hardware and medical evaluations initiated during the first and second 6 months of system operation have been continued and expanded during the third 6-month period. The evaluations are based on what has proven to be a continuing stabilized 6-month period wherein system failures which occurred during the initial shakedown period in the first 6 months have been minimized. Early trends and performance data reported in the previous semi-annual reports have been reexamined to either verify, modify, or change earlier trends.

The STARPAHC Program goal is to produce, through demonstration, comprehensive and accurate information about the feasibility of the STARPAHC concept as a solution to the problem of quality health care delivery to people in remote geographic areas. This includes information as to the operation of a relatively sophisticated "telemedicine" system functioning in a rural area. (STARPAHC is at the time of this report, still the most advanced and latest technology of communications applied to the health problems of the most numerous rural population anywhere in the world.)

The contents of this report present the highlights of the total one and one-half years of operation with emphasis on comparisons between the first year and the third 6-months. In addition, baseline data comprised of number of outpatient visits at the various health service facilities and home visits for the pre-STARPAHC period (1970-April 30, 1975) has been generated which is compared to the STARPAHC operation.

EVALUATION APPROACH

In the system evaluation, Fig. 1-1 illustrates the evaluation goals and processes. As noted in the figure, monthly data retrievals are summarized in the form of a semi-annual evaluation report (submitted to NASA for review). The hardware and medical data have been coordinated between LMSC and IHS personnel and have been integrated in this report. Cost data reflects inputs from all organizations.

For achieving the medical evaluation objectives, a method was established to (1) document field activities; (2) interview the health staff, the patients, and community residents; (3) provide special evaluation forms to be completed by the health providers; (4) review and analyze the computer printout for telecommunication data; and (5) perform a detail cost analysis of the health care system correlated with a hardware cost study.

For achieving the hardware evaluation objectives, a method was established to (1) acquire field data by daily data collection in manual records by the site personnel; (2) incorporate the data into computer-based logs; (3) reduce, analyze, interpret, and compare the raw data to obtain specific answers to satisfy the stated objectives; and (4) perform a calibration program which affords an insight into any performance change in the video/audio links of the system.

In addition, there are 3 independent investigations conducted by IHS and by NASA that will supplement the final evaluation: (1) quality of care analysis for certain specific diagnostic categories; (2) study of the history of the planning, development, and implementation of the STARPAHC Project by Rashid Bashshur, Ph.D., University of Michigan; and (3) NASA is conducting a space-oriented Medical Evaluation contracted with the Boeing Company. Results of the last study will be reported separately and independently of STARPAHC.

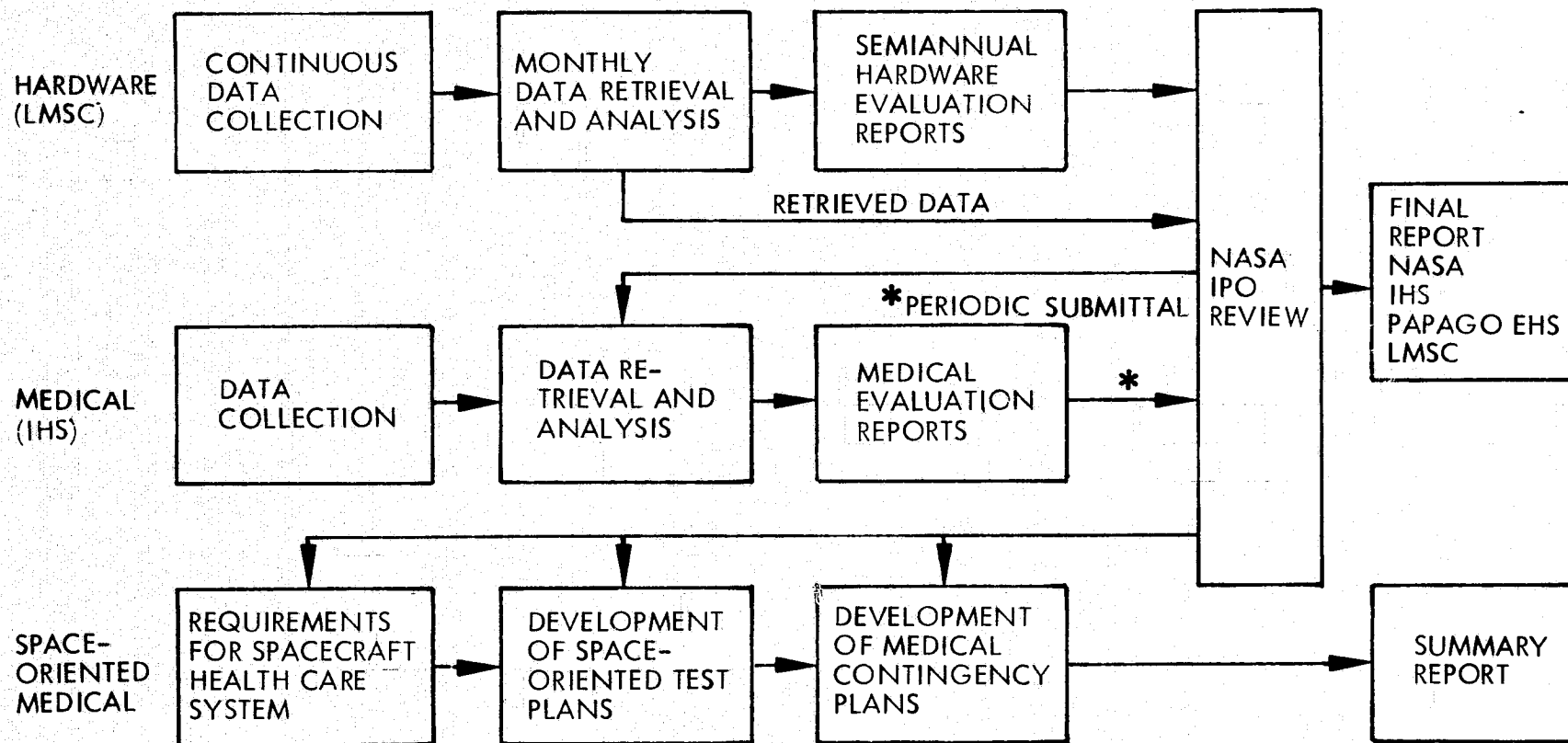


Fig. 1-1 Evaluation Information Reporting

Section 2

MEDICAL EVALUATION RESULTS

The Medical Evaluation Plan (Appendix A) has been implemented during the third 6-month period to achieve the goal of assessing the impact of STARPAHC on patient care. To quantitatively evaluate the impact and assess the improvement, if any, baseline data on patient visits was developed for pre-STARPAHC operation back to 1970. This baseline data is compared to the one-year STARPAHC operation to determine the utilization of health services before and after STARPAHC operations.

Specific questions to be answered are:

- o Is the system improving accessibility to health care?
- o Is it an improvement over the pre-STARPAHC system?

Results from studies have indicated that improved accessibility to health care has been demonstrated by 1) a rate of increase in patient visits, and, (2) increase in ratio of patients ambulatory care visits to patients. Another important measure of accessibility is that the percent of total population using services has been the greatest for those more remote districts whose closest and most frequently used health service facility is the mobile health unit.

The changing pattern of health care, as compared to the pre-STARPAHC system, on the Papago Reservation has shown an improvement in the increasing use of physicians' services at the Sells OPD, and an increasing use of CHM services by the Mobile Clinic served districts and the Santa Rosa district.

The use of telecommunications for support of the health delivery system has declined slightly during the third 6-month operation. (This is attributed to the improvement in the data system permitting less contact with Medical Records at Sells.) Improvements in the access to the health record systems obviated the need for voice contact with Sells medical records department. More visits to Santa Rosa were for routine school examinations and for influenza immunizations which do not generate a need for remote consultations. Experience and self-confidence gained by the CHMs is also reflected in the reduced use of teleconsultations.

Further experience in telecommunication operation was gained by adding experimental transmission of medical data via the Slow Scan TV from Sells to the Phoenix Indian Medical Center.

The specialized use of telecommunications in the transmission of images via Slow Scan TV for remote medical consultation was actively pursued in three areas: (1) Radiology, (2) Skin Tones and Eye Pictures, and (3) Microscopy.

2.1 SUMMARY OF FINDINGS IN PATTERNS OF HEALTH CARE CHANGES

The changing pattern of health care on the Papago Reservation is a complex picture which varies for each district. The use of the mobile clinic seems to have accelerated trends already in existence before the project started. All studies have shown an increasing use of physicians' services at the Sells OPD, an increasing use of CHM services by the Mobile Clinic served districts and the Santa Rosa district.

Home visits mostly by Papago health program workers have also increased, especially over the last year, compared with the average number of visits for the previous two years. The percent increases have been as follows:

For the 3 western districts served by the mobile unit, 103%; for the 2 northern districts near Santa Rosa health center, 129%; for the 3 districts closest to the Sells OPD, 83%; and for the central district of Sells, 159%.

It is necessary to understand the above patterns in order to be able to relate quality of care study findings, and the utilization of telecommunication services.

Two additional studies are indicated in order to correct relative utilization statistics. First, there is a need to know the use of facilities outside the reservation at the central referral hospital in Phoenix, and the primary clinic at Sacaton. It is expected that this study will increase visit/population ratios for the northern two districts, as well as revise the relative proportions of visits by site, type of service, and provider categories.

Secondly, it is necessary to know the extent to which the mobile clinic referral patterns accounted for both the increased use of the Sells outpatient department and home visits.

The greatest changes in the relative proportion of patients who receive their primary care from physicians occurred in the western three districts which are served by the Mobile Unit. The MHU is responsible for the relative decline in visits to the M.D. and the rise in visits to the CHM.

The Public Health Nurse (PHN) had formerly provided primary care when the Pisinimo clinic was operating in 1973. In 1974, the CHM replaced the nurse from the clinic. The PHN could then turn her attention to home visits and counseling and health education in the clinics at Sells.

A transfer of responsibility from physician to CHM has taken place for primary health care in the two northern districts near the Santa Rosa Clinic. The other three eastern districts show a distribution by category of provider identical to the pattern for residents of the Sells district.

The effects of these changes upon the quality of care received has yet to be determined.

The use of nurses, LPN and RN, as primary providers, has not changed over the four years for each of the 9 districts being considered.

2.1.1 Referral Patterns by Community Health Medics from the Mobile Health Unit

All patient encounter records for 6 of the 18 months of operations were reviewed by a physician. The date, patient number, diagnosis or reason for referral, type of referral and site, service, or provider category to whom referred were manually tabulated.

The major findings were as follows: During the third 6-months, the total patient visits were 1562. Total patients with one or more referrals noted on records were 525, or 34% of the total visits. Sixty-six percent (1037 patients) had no referrals. Of the 1037 patients, 315 were scheduled for a return appointment to the mobile unit. Therefore, 52.9% of the total made only one visit for their complaints, and 47.1% were either scheduled to return to the MHU or referred either from or to other services.

Referral rates by type of health care services was most for (19.7% of visits) field and community programs, especially for the Papago Disease Control programs. The Papago staff indicates that few if any patients were actually referred. The return copy of the encounter form indicates that the patient was initially referred to the MHU as a result of home visits by the Papago health workers.

The physician referrals were mostly to Sells specialty clinics for chronic conditions diagnosed or suspected by the CHM. The above rate does not include 60 televised consultations with Sells physicians that occurred during this third 6-months time period.

Referrals to Sells OPD facilities were 11.7% of MHU visits. Most of these were for physician services. Only 5 patients of 182 were referred for hospital admission at Sells.

Projections from the above data for 12 months operations would indicate that if all those referred actually went to the Sells OPD, then about 46% of the increase utilization of Sells (over the mean for two past years) by residents of the three western districts was directly attributable to the mobile unit operations. The MHU referrals would have, at the most, accounted for about 11.6% of the total visits (3399) to the Sells OPD from the 3 western districts during the same year (May 1, 1975 through April 30, 1976).

Appendix B provides a description of the MHU clinic operation.

2.2 UTILIZATION OF HEALTH SERVICES BEFORE AND AFTER STARPAHC OPERATION

Baseline data on prior-to-STARPAHC operation was collected for the years 1970 through April 30, 1975 and compared against the STARPAHC year (May 1, 1975 through June 30, 1976). Three separate studies were initiated to establish the role of the availability of advanced telecommunications through the STARPAHC Program.

The districts of residence of the patients were grouped into regional areas depending upon the one health service site closest to the district, and the site where the greatest proportion of each district's utilization occurred.

For example, the central district, Sells, uses the Sells outpatient department for the greatest proportion of services. This is also the closest site. However, residents of Sells also receive home visits, and utilize the other sites such as the San Xavier and Santa Rosa health centers, and the mobile clinic, but use them proportionately less.

The ambulatory services included in the following tables include all reporting points and categories in the computerized Health Information System (HIS). The complete list includes:

1. Sells hospital outpatient department.
2. San Xavier Health Center.
3. Santa Rosa Health Center.
4. The Mobile Health Unit.
5. Field clinics at Pisinimo, Chui Chu, Santa Rosa Ranch, and other locations.
6. Home visits by all providers, i.e., Public Health Nursing, Community Health Representatives, Mental Health Workers, Disease Control staff and others.
7. Office visits to Papago Disease Control and Papago Nutrition Programs.
8. School visits to special clinics such as for immunizations, and mental health programs.
9. Outpatient visits to contract care facilities such as the VA Hospital, St. Mary's Hospital, University Hospital, Tucson Medical Center, Pima County Hospital, and others.
10. Sites that are either unspecified or unknown, but a visit was known to have occurred.
11. Visits to tribal community centers for certain special services such as provided by the Papago Nutrition Program.
12. Visits to the referral hospital at Phoenix and the OPD at Sacaton and Phoenix.

2.2.1 First Study - Base Year/Pre-STARPAHC/STARPAHC Year operation

The first study compared health service utilization for:

- o Base Year (May 1, 1973 to April 30, 1974)
- o Pre-STARPAHC Year (May 1, 1974 to April 30, 1975)
- o STARPAHC Year (May 1, 1975 to April 30, 1976)

Two comparisons were made, the first was between the base year and the pre-STARPAHC year, and the second was between the pre-STARPAHC year and the STARPAHC year.

Visits excluded from this study are all visits for dental services, all patients who were either admitted or discharged from any hospital and school clinic visits.

The number of total patient visits for the pre-STARPAHC year compared to the base year shows a modest increase of 4.6%, while the number of total patient visits for the STARPAHC year compared to the pre-STARPAHC year showed significant increase of 7,274 patients or 19.9%. Table 2-1 summarizes the number of visits and percent change for each district study category. The totals for the nine districts are tabulated.

The changes in number of individual patients using all ambulatory services for the pre-STARPAHC year compared to the base year shows a modest increase of 54 individual patients, or 1%, while the number of total individual patients for the STARPAHC year compared to the pre-STARPAHC year showed an increase of 244 individual patients or 4.4%.

Table 2-1
 NUMBER OF VISITS AND PERCENT CHANGE TO ALL AMBULATORY
 HEALTH SERVICES (EXCLUDING DENTAL SCHOOL CUMCS)

Districts of Residence	Number of Visits			Percent Change	
	Base Year	Pre-Starpahc Year	Starpahc Year	Pre-Starpahc/ Base Year	Starpahc Year/ Pre-Starpahc Year
1. Western Districts (primarily served by mobile unit)					
• GuVo	1,701	1,845	2,458	+8.5	+33.3
• Hickiwan	2,648	2,803	3,522	+5.9	+25.7
• Pisinemo	2,031	1,986	2,325	+2.2	+17.1
1. TOTAL	6,380	6,634	8,305	+4.0	+25.2
2. Northern Districts (primarily served by Santa Rosa Health Center)					
• Sif Oidak	2,966	2,827	3,115	-4.7	+10.2
• Gu Achi	4,481	4,442	5,702	-0.9	+28.4
2. TOTAL	7,447	7,269	8,817	-2.4	+21.3
3. Southeastern Districts (primarily served by Sells Hospital, OPD)					
• Baboquivari	3,769	4,124	4,601	+9.4	+11.6
• Chukut Kuk	962	835	951	-13.2	+13.9
• Schuk Toak	2,155	2,189	2,325	+1.6	+6.2
3. TOTAL	6,886	7,148	7,877	+3.8	+10.2
4. Central District, Sells	12,944	12,954	15,603	+0.1	+20.45
5. TOTAL: 9 Districts	33,657	34,005	40,602	+1.0	+19.4

1) All dental services excluded.

2) Data from HIS as of September 1, 1976.

3) Includes all sites, IHS + tribal visits + contract care, home visits, nongovernment hospitals, etc.

Page Intentionally Blank

The ratio of patient ambulatory care visits to total patients for the pre-STARPAHC year compared to the base year shows no change, while the ratio for the one-year STARPAHC operation compared to the pre-STARPAHC year shows +0.8. Table 2-2 summarizes the changes in ratios for each village and each district. The totals for the nine districts are tabulated.

The percent of total population utilizing any ambulatory health care facility for the pre-STARPAHC years shows that for the 1973-74 period, it was 63.9% rising to 64.5% for the 1974-75 period. For the one-year STARPAHC operation, it increased to 67.3%. Table 2-3 summarizes the percent population utilizing any ambulatory health care facility for each village and each district. The totals for the nine districts are tabulated.

The general health objectives of the Papago Executive Health Staff and the Indian Health Services were stated as a goal, "To improve the health of the Papago people to the highest possible level, and to assist the Papago people to live in harmony with their environment".

The STARPAHC Program was designed to assist in meeting this goal by providing:

- o Expanded field clinic operation by use of a mobile health unit to increase utilization of health service in the three most western districts.

The results of the first study indicates that this goal of the Papago health staff and the Indian Health Service regarding the utilization of health services by the three most western districts have been achieved. The rate of increase in all three factors, (1) patient visits; (2) ratio of patients to patient ambulatory care visits by district of residence; and (3) percent of total population using services measured has been the greatest for those districts whose closest and most frequently used health service facility is the mobile unit.

More important than the rate of increase is the fact that for every measured factor, the western three districts are above or equal to those numbers for the total service unit and for the other districts in the regional group.

Table 2-2

RATIO OF PATIENT AMBULATORY CARE VISITS TO PATIENTS

Districts of Residence	Number of Individual Patients			Percent Change	
	Base Year	Pre-Starpahc Year	Starpahc Year	Base Year/ Pre-Starpahc	Pre-Starpahc Year/ Starpahc Year
Study Groups					
1. Western Districts (served by MHU primarily)					
• GuVo	298	316	344	+6.0	+8.9
• Hickiwan	475	474	513	-0.2	+9.3
• Pisinemo	322	308	343	-4.4	+11.3
1. TOTAL	1,095	1,098	1,205	+0.3	+9.7
2. Northern Districts (served by Santa Rosa Health Center primarily)					
• Sif Oidak	566	554	546	-2.1	-1.4
• Gu Achi	771	741	799	-3.9	+7.8
2. TOTAL	1,337	1,295	1,345	-3.1	+3.7
3. Southeastern Districts (served by PHS Hospital OPD primarily)					
• Baboquivari	635	666	648	+4.9	-2.4
• Chukut Kuk	176	172	176	-2.3	+2.3
• Schuk Toak	345	361	342	-5.3	+5.9
3. TOTAL	1,156	1,199	1,166	+3.7	-2.8
4. Central District, Sells (as above)	1,971	2,021	2,141	+2.5	+5.9
5. TOTAL: 9 Districts	5,559	5,613	5,857	+1.0	+4.4

1) Data from HIS, September 1, 1976.

Includes all persons who received services at all sites by IHS or tribal staff except Dental Services.

Excludes all persons discharged from hospitals.

Table 2-3

PERCENT OF POPULATION UTILIZING ANY AMBULATORY HEALTH CARE FACILITY

Districts of Residence	Population: Estimated HIS Data Base 1961 to 1975	Number Utilizing			Percent Utilizing		
		Base Yr	Pre- Starpahe Year	Starpahe Year	Base Yr	Pre- Starpahe Year	Starpahe Year
1. Western Districts							
• GuVo	507	298	344	344	58.8	62.3	67.9
• Hickiwan	719	475	474	518	66.1	65.9	72.0
• Pisinemo	529	322	308	343	60.9	58.2	64.8
1. TOTAL	1,755	1,095	1,098	1,205	62.4	62.6	68.7
2. Northern Districts							
• Sif Oidak	919	566	554	546	61.6	60.3	59.4
• Gu Achi	1,175	771	741	799	65.6	63.1	68.0
2. TOTAL	2,094	1,337	1,295	1,345	63.9	61.8	64.2
3. Southeastern Districts							
• Baboquivari	932	635	666	648	68.1	71.2	69.5
• Chukat Kuk	249	176	172	176	70.7	69.1	70.7
• Schuk Toak	484	345	361	342	71.3	74.6	70.7
3. TOTAL	1,665	1,156	1,199	1,166	69.4	72.0	70.0
4. Central District, Sells	3,193	1,971	2,021	2,141	61.7	63.0	67.1
5. TOTAL	8,707	5,559	5,613	5,857	63.9	64.5	67.3

From HIS Data Base September, 1976.

At present, it appears that the increased home visits, increased use of Sells OPD and the mobile unit accounted for almost all the increases in the three western districts in about equal proportion.

2.2.2 Second Study - Comparable 12 Month Periods Since 1970/STARPAHC Year

The second study compared health service utilization for:

- o Comparable 12-month periods since 1970
- o STARPAHC Year compared to pre-STARPAHC years 1970, 1971, 1972, and 1974.

In this study, only visits to IHS facilities on the Papago reservation were tallied. Visits included those to the dental service at Sells, San Xavier, and Santa Rosa Clinic. Visits excluded were visits to other dental services, all patients who were either admitted or discharged from any hospital, and outpatient visits to the Sacaton Service Unit.

In general, the conclusions of this study support the conclusions of the first study, but the rates cannot be directly compared because of the different methodology.

The following is a summary of the major analysis for the seven objectives covered in the second study.

First Objective

- o To compare the growth in the total demographic register versus the utilizing population.
- o To perceive any "real increase in utilizing population", particularly with regard to any MHU-served areas.

Findings: Rate of population growth between CY 1970 and FY '76 in the three western districts, on the average, exceed that of the remaining districts; 1.5 times greater in the case of demographic base and 2.3 times in the case of utilizing population.

In the case of MHU activity, the trend in demographic register increase in the three western districts was accelerated, particularly the utilizing population count.

Second Objective

- o To compare the development of IHS clinic utilization levels, district by district and overall.
- o To perceive any "real" increase in utilization rate, particularly in the districts served by the MHU.

Findings: Since 1970, utilization has increased in all districts of the reservation, more so in some than in others. Overall, the increase has been quite substantial (about 11% between 1970 and 1976).

The trend towards utilization increase has also involved the three western districts. Here the increase over the 1970 rate was 24% in 1976; 4.7% of this occurring in the period of MHU service. This may indicate that the utilization rate increase during the MHU-served period was mostly part of the general trend toward increased utilization, and at best, only moderately accelerated by MHU activity directly.

Third Objective

- o To make a general comparison of workload (outpatient visit) distribution among the clinical facilities, by district and overall.
- o To determine geographically influenced utilization patterns of IHS clinical facilities on the Papago Reservation.

Findings: Sells clinic serves all reservation districts, some more so than others. Through the years, the general trend is increased utilization of Sells by all districts, except San Xavier.

San Xavier clinic serves San Xavier district and the off-reservation population (Tucson) almost entirely.

Santa Rosa clinic serves primarily Gu Achi, Hickiwan and Sif Oidak. In 1970, it took substantial workload from Gu Vo and Pisinimo.

The Pisinimo community clinic, in the years it operated (1 day a week) took care of a substantial amount of the workload at Gu Vo as well as the Pisinimo district.

The MHU serves the three western districts almost exclusively. In its time of operation, it has absorbed all of the Pisinimo clinic workload and apparently about 1/6 of the Santa Rosa clinic workload.

Fourth Objective

- o To show the per capita IHS clinic utilization rate, based on the utilizing population.
- o To compare per capita utilization levels among the districts and to show the changes occurring since 1970.

Findings: The general trend toward increased per capita utilization is unmistakable. Some districts lagged behind others in attaining increased per capita utilization (note Baboquivari, Gu Achi, Hickiwan, and Schuk Toak in the 1970-1972 change comparison). In 1976, most of the districts attained levels between 6 and 7 visits per utilizer per year.

Substantial increases in per capita utilization in Gu Vo and Pisinimo were found in the 1970-72 comparisons, while substantial gain in Hickiwan first shows in the 1972-74 comparisons.

The gains in per capita utilization in Gu Vo and Pisinimo probably were stimulated by the opening and operation of the Pisinimo clinic (1 day a week). The gains in Hickiwan probably arose from increase in Santa Rosa outreach or increased availability of transport to Santa Rosa.

Ostensibly, Hickiwan alone shows greatly increased per capita utilization in the MHU activity period -- but it is difficult to say that this was caused by the MHU alone, since the trend started between 1972 and 1974.

Fifth Objective

- o To show the change in problem-specific workload between CY 1974 and FY 1976 (June 75-July 76) the "year of the MHU".
- o To determine whether a local surge in disease prevalence might account for differences in utilization levels.

Findings: Except for "Other Bacterial and Parasitic Diseases", the surges or declines in services for particular problems appear to be random. Since visits for "other bacterial and parasitic diseases" accounted for only 5% of the visits in 1976, both overall and the "3 Western districts", the apparent increase is insignificant. The overall conclusion is that evaluation of utilization is not affected by shifts in problem or disease prevalence.

Sixth Objective

- o To compare distribution of workload among the main facilities serving the western districts with regard to disease problem categories.
- o To ascertain whether nature of problem may have caused selective (or discriminatory) utilization of facilities.

Findings: The nature of the problem obviously affected facility utilization, particularly when comparing the Sells clinic and MHU. The higher levels of MHU utilization (accounting for 44 to 56% of the visits within problem class) involved the infectious disease problems plus cardiovascular and musculoskeletal problems. The higher level of Sells utilization occurred with tuberculosis (mostly preventive care), venereal disease, neoplasms, metabolic-nutritional, mental-behavioral, neurological, and digestive (mostly dental) problems. The combined utilization of Sells and Santa Rosa caused a low utilization of the MHU (between 29 and 38%) in 8 remaining problem areas.

Seventh Objective

- o To show the changes in utilization of the principal clinical facilities available to the western districts since 1970.
- o To show specific utilization levels of Sells, Santa Rosa, Pisinimo, and MHU clinics and changes occurring chronologically.

Findings: (1) The utilization of the Sells facility continues to increase, (2) The MHU has, in essence, taken up the load of the closed Pisinimo clinic, and has caused decreased Hickiwan utilization of the Santa Rosa clinic, (3) Years before the MHU arrived, there was decreased utilization of the Santa Rosa Clinic, by Hickiwan (and even Gu Vo) between 1972 and 1974. An earlier drop in Gu Vo utilization coincides with the Pisinimo clinic operational increase. After 1972, the physician was replaced by a CHM at Santa Rosa. After 1972, all districts increased their utilization of the Sells OPD, especially Hickiwan, Gu Vo and Gu Achi.

2.2.3 Third Study - Pre-STARPAHC Three Year/STARPAHC Year

The third study compared health service utilization for:

- o STARPAHC Year (July 1, 1975 to June 30, 1976) compared to three past years (1973, 1974, and 1975).

This study measured the changing proportion of patient visits by district to different types of health services. (IHS clinics, home visits, mobile clinic (1975 and 1976 only), school, and "other" sites).

It also measured the changing visits to different categories of health providers (i.e., physicians, CHNs, PHN, Nursing Aides, and Papago Tribal Health workers).

The distribution of visits by sex, for reservation districts, was also measured.

Visits to the dental clinic were included in these studies, as in the second study. Only reservation facilities or services were included.

For comparison purposes, the data has been grouped into six sections -- each of the three MHU districts: Gu Vo, Hickiwan, and Pisinimo; Sells, San Xavier, and all others. The others category includes districts 01, 02, 03, 07, and 09.

During the past four years (July 1, 1972 through June 30, 1976) residents of ten districts⁽¹⁾ on the Papago Reservation had approximately 167,459 reported out-patient/field contacts for an average of 4.4 contacts per population⁽²⁾ and an average of 6.6 contacts per utilizing population⁽³⁾. The average contacts annually are 41,864 while there were 6,330 average number of individual contacts annually.

(1) Gila Bend district residents are excluded from this analysis.

(2) Population data used is based on September 1975 information as reported from IHS.

(3) Source - HIS printouts.

Findings: There are three distinct trends emerging from the data: (1) IHS services delivered in the field outpatient/clinic setting are becoming more physician oriented and controlled, as reflected in the increasing number of visits with either the physician or physician assistant listed as primary provider, (2) home visiting by PHNs has decreased as percentage of the total, and (3) utilization rates for females are growing more rapidly than utilization rate for males. To summarize:

1. Total outpatient/field contacts have shown a steady increase during the past four fiscal years.
2. San Xavier and Sells have the largest percent of the population contacted, and also the highest average number of visits per patient.
3. Gu Vo is at the bottom of the list in the percent of population who get service, but ranks high in the average number of visits per utilizing population.
4. Visits by Public Health Nursing personnel dropped sharply in 1973 and have not regained 1972 levels of service in any district except San Xavier, where in FY 1976 they exceeded the FY 1973 level of service.
5. Patients living in the Pisinimo and San Xavier districts are the most likely to receive home visits from PHN personnel while those living in the Sells and Hickiwan district are the least likely to receive such service.
6. Gu Vo patients average more home visits per population but rank third (behind San Xavier and Pisinimo) in home visits by PHN personnel.
7. The largest decline in home visiting has been in districts 01, 02, 03, 07, and 09. In 1973, nine percent of all contacts were reported as home contacts. In FY 1976, the percentage dropped to six percent.
8. Total home visits have increased by a percentage of the total health service.
9. Physicians assistants visits have increased to residents of all districts with San Xavier showing the least increase.
10. Males outnumber females in six of the ten districts (Gu Vo, Hickiwan, Pisinimo, San Xavier, Chukut Kuk, and Schuk Toak) but outpatient, field visits show about 57 percent female to 43 percent male ratio. Doctors see proportionally more males than do CHM's.

11. Dentists report more visits to males than females in Gu Vo, Hickiwan, and Pisinimo districts. (4 year total).
12. In those instances where all service reported has been at the MHU (Sept. '75 to Mar. 1 '76) females were seen an average of 2.3 times each while males average 2.0 visits each.
13. Only at Sells do CHM's see more males than they do female patients.
14. There has been an increase in the number of patient contacts by tribal health workers. The largest increase is seen in the three districts served by the mobile unit.
15. Visits to LPN's as primary provider is approximately double the number made to RN's as primary provider.
16. During the four year period there has been a total of 6,978 visits by tribal health workers and a third of these have been home visits. In FY 1976, home visits accounted for over half of the tribal visits in the MHU districts, but less than half of those in Sells and all other districts were home visits.

SITE OF SERVICE BY TRIBAL HEALTH PROGRAM

	<u>Home</u>	<u>Other Sites</u>
MHU Districts	589	373
Sells and All Others	650	799

2.3 MEDICAL UTILIZATION OF STARPAHC EQUIPPED FACILITIES AND TELECOMMUNICATIONS

2.3.1 Medical Utilization of STARPAHC Equipped Facilities

Visits to the Mobile Clinic during the third reporting period (May through October 1976) compared very closely with the visits during the first reporting period (May through October 1975); 1497 vs 1601. Although there were slight variations in the month vs month comparisons, these differences were considered insignificant. When the first reporting period is compared with the third for the Santa Rosa Health Center, we find an increase during the third period; 2330 vs 2634. This 11.5% increase is attributed to school physicals and influenza shots during June 1976 and September 1976.

2.3.2 Utilization of STARPAHC Telecommunications

The use of telecommunications for support of the health delivery system has declined slightly during the third reporting period compared with either of the two previous periods.

On Table 2-4, the change in patient visits and number of consultations for three reporting periods are shown. Since it is well known that seasonal illness and programs have had a great impact upon visits to facilities, the time comparison discussed is between May through October of 1975 and 1976 (i.e., the 1st and the 3rd reporting periods).

There are two known reasons for this noted decline, both in absolute numbers, and as a percent of patient visits. One is that the data transmission system has been performing much more successfully in the last period. Therefore, there is less need for the mobile unit to contact medical records at Sells.

Table 2-4

**UTILIZATION OF STARPAHC EQUIPMENT FOR PATIENT CONSULTATION
FROM THE FIELD CLINICS TO SELLS
(All Modes of Consultation)**

Evaluation Period	Site						Total Both Sites		
	Mobile Clinic			Health Center					
	Visits	Consults.	%	Visits	Consults.	%	Visits	Consults.	%
First 6 months	1,601	308	19.2	2,330	79	3.4	3,931	387	9.8
Second 6 months	1,776	330	18.6	2,883	106	3.7	4,659	436	9.4
Third 6 months	1,497	280	18.7	2,634	88	3.3	4,131	368	8.7
Change in patient visits (first/second 6 months)									
Number	+175	+22		+553	+27		+728	+49	
Percent	+10.9	+7.1		+23.7	+34.2		+18.5	+12.7	
Change in patient visits (first/third 6 months)									
Number	-104	-28		+304	+9		+200	-19	
Percent	-6.5	-9.1		+13.0	+11.4		+5.1	-4.9	

Although the mobile clinic was out of service for only 6 days during the last period compared with 8 days during the first period, there were 4 days when physicians worked on the unit. This year, more visits to Santa Rosa were for routine school examinations (September) and for influenza immunizations (October). These reasons for visits are less likely to generate a need for remote consultation.

2.3.2.1 Use of Television

There has been significant turn-over in physician personnel in the 18-months of operation while the CHM complement has remained fairly stable. Although the latest group of physicians' attitude toward the use of television for consultation has become more negative, the proportionate use of TV by the CHM has not changed appreciably. These rates are shown in Table 2-5. Although the need for television has remained a relatively constant proportion of visits, at 3%, there was a 15% increase in the number of consultations using television during the third period compared with the first period.

During the month of October, the Sells systems operator was asked to not transmit routinely the consultant's image via black and white television to the field, unless specifically requested. Only two requests were made for the eight consultations during the month.

The monthly variations in the rate of TV consultations per patient visits ranged from 5.7% to 0% for the mobile clinic, and from almost 4% to 0.4% for Santa Rosa.

The highest rates of teleconsultations for the MHU occurred when two relatively inexperienced CHMs were assigned together in July and August; the lowest rate for MHU and for Santa Rosa Health Center occurred during the months when the most experienced CHM was assigned for most of the month.

The preceding tables do not include six consultations held between the physicians at Sells and consultants in Phoenix using the slow scan television system. No evaluation data was obtained beyond that reported by the systems operator. Roentograms were transmitted in all 6 cases.

Table 2-5
PATIENT CONSULTATIONS USING TELEVISION

Evaluation Periods	MHU			SRHC			Both	
	No. of Visits	No. of TV Consults. With M. D.	Ratio: TV Consults. / No. of Visits	No. of Visits	No. of TV Consults. With M. D.	Ratio: TV Consults. / No. of Visits	No. of TV Consults.	Ratio: TV Consults. / No. of Visits
First 6 months	1,601	49	1:32.7	2,330	63	1:37.0	112	1:35.1
Second 6 months	1,776	51	1:34.8	2,883	95	1:30.3	146	1:44.3
Third 6 months	1,490	46	1:32.4	2,760	83	1:33.3	129	1:32.9
Change in Patient Visits/Consultations (First/third 6 months)								
Number	-111	-3		+430	+20		+17	
Percent	-6.9%	-6.1%		+11.4	+31.7%		+15.2%	

There were 15 x-ray image transmissions from the MHU to Sells during the third 6-months. This compared favorably with the prior year transmission of 31 x-rays for teleconsultation purposes.

The communications systems elements that were not used for patient consultations during this period include the ECG, the PAM unit, and the telemicroscope. No need occurred for relaying pictures from the field clinics through Sells to Phoenix via slow scan.

2.4 PERCEIVED VALUE OF TELECOMMUNICATIONS

Since the last report, one more series of interviews were completed in September by a behavioral scientist from outside the Office of Research and Development. A complete analysis will be finished by May. The following is a brief summary of his findings.

Physician's Attitude. There is definitely a consensus among the latest group of physicians that the TV, either color or black & white, is not needed. They feel the picture does not, in most cases, add to their ability to diagnose. In the rare cases that it does help, it is necessary to assess its cost effectiveness. Also, the time required to set up and leave what they are doing is excessive. This factor is a necessary part of any telemedicine system. However, they all feel the MHU with voice and data communication is important for patient care.

CHM Attitude. The CHM finds the system highly acceptable because it gives direct access to medical consultation and backup. In most cases, the CHM said it would be more difficult to work alone in isolated settings without STARPAHC. Four out of five CHMs feel that TV is important, while all MDs do not. Poor attitude of MD toward TV makes CHM not want to use it as much and, therefore, more use of voice only is taking place.

Other Health Professionals. Many other professionals have recommended that STARPAHC could be used for more things than it is now used for, i.e., physical therapy and health education. This capability in form of external monitors/speakers is available in the MHU.

Patient Considerations. From the data available, there seems to be no problem with patients' acceptance. Certainly, utilization by patients has not declined. The Mobile Unit is seen by most patients as a great convenience and an improvement in the level of health care. CHMs are well accepted.

Attitude Observations. The perceived value of telecommunication from the viewpoint of the physicians and the CHM is greatly influenced by the degree of experience with the system. When the CHMs feels the need for assistance he welcomes the capability of communicating with the physician. The physician, however, often judges these communications as less necessary when the CHM's diagnosis or plans are appropriate.

Table 2-6 compares the teleconsultation value judged by both CHM senders and physician receivers for the third 6 month study period. Both the CHM senders and the physician receivers reported 96.4% of the consults were critical/important or useful in the care of the patient.

This data is weighted in favor of better describing value judgements about patient consultations from Santa Rosa Health Center (61.4% of total known consultations reported), than from the Mobile Unit (only 50% reported).

2.5 FAILURE RATIOS FOR CONSULTATIONS

The following tabulates those patient consultations during which any communications system failed to operate, and was noted on the evaluation forms by either the sender or receiver. Each consult was tallied only once.

The Table 2-7 shows no significant change in the failures as compared with other reporting periods (30 in the first 6 months and 22 in the second 6 months); all are about 18% of the consultations reported by IHS staff.

Table 2-6

**PERCEIVED VALUE OF TELECONSULTATIONS BY SENDER (CHM)
AND RECEIVER (MD)***

Health Providers (Third 6 months)

Value of Each Consult	CHM Sender		MD Receiver		Total of Both	
	No.	%	No.	%	No.	%
1. Critical for the proper care of this patient	17	17.9	4	5.6	21	12.6
2. Important or useful	78	82.1	62	86.1	140	83.8
3. Of little or no value	0	0	6	8.3	6	3.6
4. Confusing or harmful	0	0	0	0	0	0
Totals	95	100.0	72	100.0	167	100.0
Total forms received	99		76		175	
Percent answered	95.9		94.7		95.4	

*CHM - Community Health Medic in Field

MD - Physician at the Sells Hospital

Table 2-7

CONSULTATIONS SUMMARY

Month	Number Failures Reported	Totals		Failures (%)	
		Consults Reported by IHS	Consults Held	Consults Reported	Consults Held
May	13	45	65	28.89	20.0
June	10	54	82	18.50	12.2
July	7	35	68	20.00	10.29
Aug	1	33	62	3.03	1.61
Sept	3	21	58	14.29	4.6
Oct	1	9	42	11.11	2.4
TOTALS	35	197	374	17.77	9.36

Table 2-7 summarizes the failures by percent of both consults reported and total consults held. The latter figure is from the equipment usage log maintained by the Sells Systems Operator.

Of the 35 patient consultations where a "failure" was reported by IHS staff, 4 were data terminal failures, 12 were voice system failures, 11 were color television rating of either "failed" or "poor" signal quality, and 8 were other equipment or systems.

2.6 EVALUATION OF SLOW SCAN TELEVISION

The evaluation of Slow Scan Television for remote medical consultations was carried out for three areas: (1) Radiology, (2) Skin Tones/Orbital Pictures, and (3) Microscopy. The general purpose of the radiology evaluation was to transmit selected test films from the primary care hospital at Sells to an expert diagnostic radiologist at the Phoenix Indian Medical Referral Center and compare his readings (upon special reporting forms) with the originals. The general purpose of the skin tones/orbit picture evaluation was to determine the adequacy of transmitting patient images in color. The purpose of transmitting microscopic slide data was to test the usefulness, feasibility, and the overall capabilities of televised microscopy for interpreting smears of peripheral blood and bacterial specimen.

2.6.1 Evaluation of Slow Scan Television - Radiology⁽¹⁾

Four specific experiments were carried out to evaluate the radiographic quality of the transmitted x-rays and to determine the diagnostic validity of interpreting transmitted chest x-rays by an expert diagnostic radiologist.

Experiment 1. (Whole Chest Disc Readings). The three objectives established for the experiment were to determine if:

- o Single transmissions of one televised view of the whole chest would be a reliable method for interpreting chest x-rays.
- o The size of film was related to the reliability.
- o The radiographic quality of the film was related to reliability.

(1) Description and Evaluation of a Slow-Scan Television Link for Remote Medical Consultations - Radiology, DHEW, IHS Office of Research and Development, James W. Justice, M.D., USPHS.

Eighty-six chest roentograms were randomly selected from a group of 121 test films for transmission. The transmitted images were stored on a VAS recorder disc in the first experiment.

Sixty-five large chest film sizes (14 x 21 in.) and twenty-one small chest film sizes (less than 14 x 21 in.) were transmitted.

"Radiographic quality" established to evaluate the transmission of the x-ray images was defined as adequate or inadequate in the judgment of the physicians. All films agreed upon by at least two of the three physicians were classified as either adequate or inadequate quality. Twelve large and three small-size inadequate films were transmitted, while 65 large and 21 small adequate films were transmitted.

The radiologist reader at the Phoenix Indian Medical Center was instructed to report whether each film or televised image was either "negative" or "positive" for pathology. If the film or image was considered "positive", then the reader was asked only to check the tissue, or tissues involved, and mark the location upon a grid diagram. Analysis of the televised positive/negative pathology readings by the radiologist were compared to the positive/negative pathology interpretations given to the original films. Comparisons were made on a first and second reading of the original films.

Results of Experiment 1 indicated that:

- o Reliability is not acceptable for one televised view of the whole chest.
- o Increasing the perceived resolution from 500 to 1,000 lines per square inch by using the smaller size film did not seem to improve the reliability of the interpretation and may have made them worse.
- o Films of inadequate radiographic quality seem to be as reliably read on television as in the original form, but the percent agreement in both cases is low.

It should be noted in the experiment that only 18 small-sized, adequate quality x-rays and only 15 inadequate quality x-rays were transmitted.

Experiment II. (Whole Chest Disc/Videotape Readings). The objective of this experiment was to measure reliability of interpretation of the readings for the TV disc storage with those from the videotape storage, and with original films. The methods were the same as for Experiment I, except for the reduction from 86 transmissions to 67 due to transmitting or recorder malfunctions.

Results of Experiment II were in agreement with those of Experiment I and the conclusion is that reliability is not acceptable for either disc or video tape readings, compared with dual readings of the original films.

Experiment III. (Whole Chest Disc/Disc Videotape Readings). The objectives of this experiment were to:

- o Measure reliability of the interpretation using different transmission techniques from those used in Experiments I and II.
- o Compare the above objectives for both disc and videotape readings.

The transmission instructions for Experiment III are as follows:

- o Three pictures of the same film transmitted.
- o One whole chest view transmitted as in Experiments I and II.
- o One view of the upper one-half of the film.
- o One view of the lower one-half of the film.

Fifty-two films were transmitted; however, due to a failure to videotape some transmissions, only 37 of the films transmitted were available for reading all 3 views on videotape.

The reliability of the interpretations of the videotape and disc readings compared with the first reading of the original film was 100% for the 32 films from the first two experiments. Of these 32 films, both original readings agreed 30 times (19 negatives and 11 positive pathology readings).

The videotape and disc readings compared with the original readings perfectly and with each other. The reading of five out of the nine true positive pathology films (proven by tissue examination) was also 100% reliable for both videotape and disc readings as far as the positive and negative pathology readings; however, both the videotape and disc readings missed the same lesions and/or location of the tissue involved. From densitometer analysis of the lesions on original films, there seems to be no consistent explanation for the missed diagnosis. During the case conference with the radiologist following the experiment, all nine films and television images were re-read and discussed. Lesions were seen on the monitor, but the radiologist stated "were not appreciated when the film images were mixed in with normals during the transmission sequence".

This experiment resulted in the highest reliability indices of the three experiments. The cost of commercial telephone service rather than FTS for transmission would increase approximately three times due to transmitting three views instead of one for each chest film.

Experiment IV. (Transmission of Whole, Upper and Lower One-Half, and Enlargement of Specified Portion of Chest Films). The objectives of this experiment were to:

- o Measure the impact of enlargement of specified portions of chest film upon accuracy and reliability of interpretation.
- o Pretest another methodology that more closely simulates the physician and consultant interactive mode of transmission, and measure effect upon accuracy and diagnosis.

A sample of 22 films to be transmitted was selected from the 54 films used in Experiment III. The enlarged view of a specified portion of the large chest film did not increase the accuracy of interpretation over the previously transmitted three views for each chest film.

2.6.2 Evaluation of Slow Scan Television - Skin Tones and Orbit Pictures

Specific experiments were carried out in twelve days to determine the effectiveness of the color TV system to transmit adequate skin tones and orbital structure over the slow scan TV from Sells to Phoenix. The experiment objectives were to identify/distinguish:

- o Papules or macules of 3 mm diameter or less upon dark skinned individuals
- o Scars as either raised or depressed areas
- o Pupillary size and detail.

Limitation of camera capabilities resulted in inadequate color differentiation within the skin tone range of hue for diagnosis of dermatological lesions. The real time color system does not show papules or macules of 3 mm diameter or less upon dark skinned individuals. The color system also fails to distinguish 4 to 5 mm diameter or less red lesions in dark skinned subjects, but does transmit down to 3 mm lesions in fair skinned subjects. Streaks of cellulitis (simulated with red flow tip markers) 4 to 5 mm wide could not be distinguished in dark skinned individuals.

Scars could not be conclusively identified as either raised or depressed areas, unless verbal clues were also given.

Close-up views of skin and mucoral surfaces (i.e., magnifications of 5 to 7 times) showed highlighted areas with a green yellowish tinge. This problem was greatly reduced by using filters, but persisted.

Similar difficulties were encountered in the use of slow scan color transmissions for ophthalmologic problems. The best color transmissions needed to use 500 watts of light. This amount was not tolerated by the subjects. Excessive tearing resulted. Each tear was highlighted and the same green-yellow hue artifact was introduced.

The detail of eye lids, lashes, iris and scleral vessels was good, but more easily achieved using the black and white system. Both color and black and white failed to distinguish pupillary size and detail in subjects with pigmented irises. Pupillary contours were easily visualized in blue-eyed persons.

The difficulty of obtaining patients with skin and eye problems, plus the time needed to transmit pictures in a room not designed for this function, the recognized discomfort to the patients, and the known shortcomings of the system led to the decision to curtail non-interactive diagnostic research in these areas.

Both color and black and white slow scan systems, however, are available for direct, interactive use between Sells physicians and Phoenix specialists for diagnostic problems as the need arises.

2.6.3 Evaluation of Slow Scan TV-Microscopy

The system has been adjusted to transmit adequate color images of peripheral blood cells at 1500 magnification. Double blind readings are now in progress with the objective of correct identification of white blood cell types over the television monitor via the slow scan system.

Attempts to transmit bacteriological specimens were not satisfactory. The receiver in Phoenix could not distinguish gram positive (red) from gram negative (purple) stained bacteria in slides with mixed flora. Neither could rod shapes be distinguished with certainty from cocci due to exceeding the limits of resolution in the system.

Other experiments in progress involve transmission of cytology slides for cancer screening.

2.6.4 Evaluation of Slow Scan Television Summary

The use of slow scan television for the transmission of x-ray images has indicated that the hardware performance seems to be reliable enough and the results achieved valuable enough to justify continued experimentation.

The use of slow scan television for the transmission of patient examination images has demonstrated that the existing system requires considerable improvements in equipment, lighting, and space. Under laboratory conditions, IMSC Engineering has demonstrated that (1) by using studio quality color cameras rather than the low-cost cameras presently being utilized, (2) providing studio-type balanced lighting, and (3) providing sufficient space to maneuver this equipment that quality transmission of color images can be achieved. It is necessary to demonstrate this in controlled clinical surroundings.

The feasibility of televised microscopy from the technical viewpoint has been proven; however, it requires considerable experimentation. The combined problems of optics, alignment, and color quality must be resolved. Resolution of this problem is the same as for patient examination -- selection of quality color cameras.

Section 3

SYSTEM USAGE

3.1 HARDWARE EVALUATION APPROACH

The Hardware Evaluation Plan (Appendix B) has been implemented during both the first, second, and third 6-month periods to achieve three goals:

- o STARPAHC Improvement
- o Exportability Potential *
- o Acquisition of Space System Design Data

Figure 3-1 illustrates the hardware evaluation approach. Acquisition of field data is accomplished through the individual site personnel daily records (system operator - telecommunication records, computer operator - software/hardware, maintenance technician - daily maintenance/logistic records, site manager - summary records and IHS daily operation records). Data from these records are entered into four computer-based or manual logs. These log entries are periodically cross-checked and correlated with the IHS medical evaluation data compilations.

Computer Software/Terminal usage as shown in Fig. 3-1 was determined by developing a new software program (STAT5 - On-Line Terminal Statistics). STAT5 allows the user to access five reports which yield usage data.

Raw data in each of the four computer-based logs are reduced to a summary print-out giving pertinent data as indicated in Fig. 3-1. Next, the reduced raw data are subjected to an analytical process that yields products such as arithmetical ratio, usage trends, performance acceptability ratios, cost effectiveness, transmission usage time, monthly comparison, and frequency/distribution of equipment usage.

Usage data on subsystem equipment other than Telecommunication Equipment (TCE), e.g., Quijotoa Relay Station (QRS) equipment, MHU vehicle and supporting equipment, computer and peripheral support equipment, and power equipment are collected from the maintenance technician's daily records and from the MHU user's daily operational notes. During this reporting period, the new slow-scan TV equipment was installed and was well received.

ACQUISITION
OF FIELD DATA

LOGS	DATA	ANALYTICAL PROCESS	PRODUCTS	CONCLUSIONS/ RECOMMENDATIONS	RESULTING ACTION	EVALUATION GOALS
EQUIPMENT USAGE	• USAGE TREND • FAILURE RATES • QUALITATIVE JUDGMENT OF PERFORMANCE • EQUIPMENT FAILURES IDENTIFICATION • MEDICAL USE • TELECOMMUNICATIONS • CHM/PHY USE	• STUDY OF TERMINAL PRINTOUT AND COMPARISON WITH USAGE LOG • ARITHMETICAL RATIO OF TIMES • INVESTIGATION OF PAST HISTORY AND SITE DATA	• HIGH SUCCESS • HIGH % IN GOOD CATEGORY • MEDICAL USE % • CHM/PHY RATIO • LOW USE/HIGH SUCCESS RATE • HIGH FAILURE RATES OCCURRED IN HIGH USAGE RATE EQUIPMENT TYPES	• INVESTIGATION LOW USAGE RATE • INVESTIGATE FAILURES AND DETERMINE CAUSE AND CORRECTIVE ACTION • DESIGN OPERATION CHANGE RECOMMENDATIONS		
EQUIPMENT TROUBLE & CORRECTIVE MAINTENANCE	• DESCRIPTION OF INCIDENT • TIME AND LOCATION OF FAILURE • ACTION TAKEN • PARTS REQUIRED • TIME REQUIRED FOR CORRECTION	• ACTUAL COUNTS OF CATEGORIES • ARITHMETICAL PERCENTAGES AND RATIOS	• COST OF REPAIR • ON-LINE VERSUS DOWN TIME • WHY-HOW INCIDENT OCCURRED • CORRELATION OF EQUIPMENT USAGE FAILURES	• REV/MOD MAINTENANCE PROCEDURES • SPARES RECOMMENDATIONS • DESIGN RECOMMENDATIONS • OPERATIONS RECOMMENDATIONS		
EQUIPMENT PREVENTIVE MAINTENANCE & CALIB.	• PREVENTIVE MAINTENANCE SCHEDULE • DESCRIPTION OF WORK • MATERIALS USED • FREQUENCY REQUIRED	• ANALYZE LOGS ABOVE USING CALENDAR PLOTS OF FAILURE/MAINTENANCE INCIDENTS	• COMPARISON BETWEEN FAILURES & SCHEDULED MAINTENANCE • COST OF PREVENTIVE MAINTENANCE • COST OF CALIBRATION	• REV/MOD MAINTENANCE PROCEDURES, CALIBRATION SCHEDULE RECOMMENDATIONS		
COST	• EQUIPMENT REPLACEMENT COST • COST OF REPAIR • PREVENTIVE MAINTENANCE/CALIBRATION COST • INTERIM MEASURE COST	• ARITHMETICAL RATIOS OF ORIGINAL COST VS REPAIR COST AND OPERATIONAL COST	• COST EFFECTIVE RATIO • SPARES COST • LOGISTIC COST	• FUTURE SELECTIVE CRITERIA • DESIGN COST IMPROVEMENT • OPERATIONAL COST IMPROVEMENT		
COMPUTER HARDWARE/ SOFTWARE STATISTICS	• USE AND PERFORMANCE STATISTICAL DATA	• DIRECT READOUT OF COMPUTER PRINTS	• ENTRY ERRORS • TERMINAL USAGE • FAILURE ANALYSIS	• TERMINAL SELECTION CRITERIA • APPLICATION SOFTWARE PROGRAMS SELECTION		
SYSTEM OPERATION LOG	• SUMMARY OF OPERATIONAL ACTIVITY AND FIELD REPORTING	• REVIEW FOR PROBLEM/SOLUTION ACTIVITY-ACTION EFFECTIVITY • SYSTEM COHERENCE AND LOGISTICS	• WEEKLY HIGHLIGHTS • EFFECTIVITY OF DATA REPORTING	• ACTION TAKEN AND RESULTS ASSIGNMENTS • SYSTEM CHANGE RECOMMENDATION		

- STARPAC SYSTEM CHANGES
- COST IMPROVEMENTS
- MAN-MACHINE IMPROVEMENTS
- DESIGN IMPROVEMENTS
- ENVIRONMENTAL IMPACT ON DESIGN
- DESIGN CHANGES IN BASIC SYSTEM

- EQUIP. SELECTION ANALYSIS (BASED ON USAGE APPLICATION)
- PARAMEDICAL PERSONNEL EQUIPMENT ACCEPTANCE
- RELIABILITY OF SYSTEM
- MAINTENANCE REQUIREMENTS
- DESIGN IMPROVEMENTS
- COST EFFECTIVE ACTION

IMPROVEMENT
OF STARPAC

DESIGN
EXPORTABILITY

SPACE STATION
APPLICATION

SEMI-ANNUAL
EVALUATION
REPORT

Fig. 3-1 Hardware Evaluation Approach

3.2 TELECOMMUNICATION EQUIPMENT (TCE) USAGE

The cumulative total TCE usage one and one-half year box score for all TCE types is shown in Table 3-1, which lists the use, quality, and purpose of the equipment. Failures occur when, in the judgment of the system operator and/or the health care personnel, the transmission is not acceptable. A quality rating ranging from Excellent to Failure is used in the evaluation process. Accuracy of quality of transmission (for evaluation purposes) always assumes a good or excellent rating. Ratings of Fair, Poor, or Failure constitute an anomaly and are isolated for detail analysis.

Table 3-1 shows that the number of telecommunications during the third 6-months slightly declined over that experienced during the prior two 6-month periods. Comparing the first 6 months against the third 6 months, for seasonal comparison, shows that there was a 5.3 percent decrease during the third 6 months. Failures showed a significant reduction during the third 6 months (19 compared to an average of 38 failures for the prior one year). The quality of transmission increased to 91.9 percent in the third 6 months compared to 90.0 percent in the Good quality for the first and second 6 months.

The most significant difference between the first year and the third 6 months is the high percentage attributed to medical use (62.3%). This is attributed primarily to the increase in the number of telecommunications between the CHM/Physician. Gross PARs for the third 6-months is slightly improved over the prior year due to the reduced number of failures experienced during the third 6 months. Table 3-2 provides data on each of the months making up the third 6 months. It is noted that during September and October, there was a significant increase in the CHM/Phy telecommunications and decrease in the MED/Admin telecommunications. This is attributed to change of personnel (less experienced CHM's and RN's in the field) and the improvement in VHF performance.

Table 3-1

TELECOMMUNICATION TCE USAGE BOX SCORE
(18 Month Operation)

Equipment Type	Use		Quality					Purpose					
	Telecom	Failures	Exc.	Good	Fair	Poor	Not Acc.	C/O	Trbl. Shoot	Comm.	Cont.	CHM/Phy.	MED/Adm.
All Starpahr (1st 6 months)	1,976	43	33	1,764	95	41	43	177	26	611	194	473	495
All Starpahr (2nd 6 months)	2,022	33	3	1,793	149	44	33	121	12	458	188	530	713
All Starpahr (3rd 6 months)	1,872	19	7	1,721	107	18	19	88	1	472	145	610	556
Grand Totals	5,870	95	43	5,278	351	103	95	386	39	1,541	527	1,613 (3,377)	1,764

Performance Acceptability Ratio (PAR)		1st 6 Months (%)	2nd 6 Months (%)	3rd 6 Months (%)	18-Month Operation (%)
• Gross PAR	$= \left(1 - \frac{\text{Failures}}{\text{Telecommunications}}\right) 100 = \%$	97.82	98.37	98.38	98.19
• Net PAR	$= \left(1 - \frac{\text{Anomalies (fair, poor, failures)}}{\text{Telecommunications}}\right) 100 = \%$	90.94	88.82	92.30	90.69
• Medical Use	$= \frac{\text{Medical Purpose (CHM/PHY \& MED/ADM)}}{\text{Telecommunications}}$	48.99	61.47	62.28	57.48
• Teleconsultation Use	$= \frac{\text{Teleconsultation Contacts (CHM/PHY)}}{\text{Telecommunications}}$	23.94	26.21	32.58	27.58

Table 3-2

TELECOMMUNICATION USAGE BOX SCORE/MONTH
(Third 6 Months)

Use			Quality					Purpose					
1976	Telecom	Failures	Exc.	Good	Fair	Poor	Failure	C/O	Trbl. Shoot	Comm.	Contr.	Chm/ Phy.	Med/ Admin.
May	256	2	0	221	10	6	2	23	0	58	25	67	72
June	438	5	2	395	34	2	5	22	0	106	41	129	140
July	325	5	2	283	30	5	5	15	1	57	26	135	91
August	287	0	0	279	6	2	0	7	0	56	17	133	74
September	287	6	3	263	13	2	6	14	0	77	20	113	63
October	279	1	0	263	14	1	1	7	0	107	16	33	116
TOTALS	1,872	19	7	1,721	107	18	19	88	1	472	145	610 (1,166) Medical Use	556

3.3 QRS USAGE

The QRS equipment operates Monday through Saturday. The power supply configuration consists of a wind driven generator (WDG) as primary power with a 6 kilowatt diesel generator used as backup. A 2.5 kilowatt propane generator is available for switchover in an emergency. The diesel generator has a 300 gallon tank and an auto-control circuit. The WDG and diesel power systems usage are monitored by strip recorders located at the hospital's operator console. The WDG operated approximately 400 hours (50% of required) during the third 6 months.

The QRS has fixed antennas for communication with Santa Rosa and Sells and a rotatable antenna which is directed to the MHU. The rotatable antenna operated 100 days out of the 103 days needed. Three days were needed for maintenance and repair.

The Bramco Decoder/Encoder installation between Sells and the QRS has continued to perform excellently and has alerted personnel to the status of the QRS power source with a time-line record.

3.4 MHU USAGE

The MHU was in continuous use (4 days a week) during the third 6-month operational period except for two 2-day out-of-service periods due to mechanical failures and a one 4-day out-of-service period due to unavailability of medical staff (8 days total). The Traveleze trailer equipped with VHF voice and digital data capability served during the two 2 days out-of-service period, thus keeping health care impact to a minimum. An average of 271 miles per week were traveled during the third 6-month operational period, bringing the total miles traveled during the third 6-months to 6179 miles. A total of 20,204 miles presently is on the vehicle.

3.5 COMPUTER AND PERIPHERAL EQUIPMENT USAGE

During the first year of operation, the computer was one of the major maintenance items. A summary of the computer usage during the first year and the third 6 months showed the following:

	<u>1st-Year Operation</u>	<u>3rd 6-Month Operation</u>
Total Operation Time (Hours)	2252	1377
Total Operation Downtime (Hours)	250	31
Percent Operational Downtime	11.1%	2.2%
Total Varian Service Calls	13	4
No. of Operational Days Between Failures	22	32.5
No. of Operational Hours of Each Failure	20.4	7.8

All of the above usage statistics show a significant improvement over the prior one-year period. The UPS was installed and checked out June 20, 1976, which accounts for this improved operational record.

3.6 COMPUTER SOFTWARE/TERMINAL USAGE (See Glossary of Computer Terms, pg. v)

3.6.1 Computer Software

The computer software is divided into two major functions: (1) Data Concentrator and (2) MEDICS Application Software. Generally, the MEDICS Application Software usage reflects about 30 percent of the total computer usage, and the Data Concentrator function utilizes about 70 percent.

The usage of the Data Concentrator, MEDICS, and the terminals was related to the number of requests recorded. There are approximately three lines of input associated with each request for the Data Concentrator. These inputs averaged between 1200 and 1500 per month.

The MEDICS software usage is divided into three categories: (1) Users, (2) Program Usage, and (3) Data Base Usage. Relationship between Program and Data Base is illustrated in Fig. 3-2.

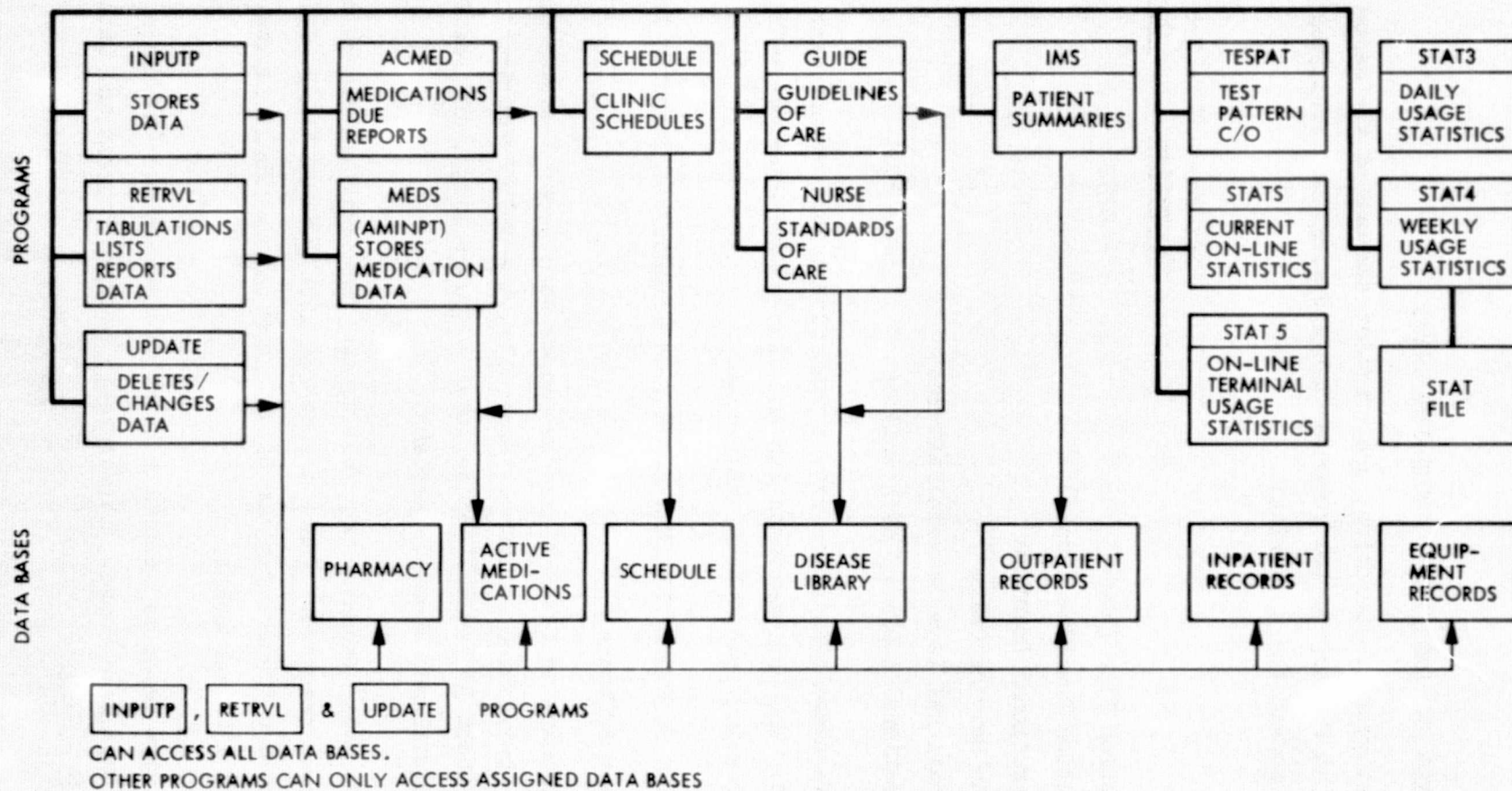


Fig. 3-2 Programs/Data Bases Relationship

The eight main users of MEDICS are Sells Medical Records, Programmer, LMSC, HPSC OMIS, Paramedics, Santa Rosa Medical Records, Nurses, and Others. Sells Medical Records, LMSC Programming, and the Santa Rosa Medical Records account for 87 percent of the total usage. There are five main programs available to the users: (1) RETRVL, (2) INPUTP, (3) SCHEDULE, (4) UPDATE, and (5) OTHERS. The RETRVL, INPUTP, HIS, and SCHEDULE account for 78 percent of the total usage.

There are 3 main data bases: (1) Schedule, (2) Equipment Records, and (3) Active Medications. The Schedule and Equipment Records data bases account for 93 percent of the total usage.

3.6.2 Terminal Usage

In determining terminal usage, both the statistics on the Data Concentrator and MEDICS Application program usage were reviewed. Those terminals devoted primarily to patient health care represent 81 percent of the total terminal usage. These terminals are located in the Sells Medical Records (3), Santa Rosa Clinic (2), MHU (2), San Xavier Medical Records (2), and the Pharmacy (1). The remaining terminals reflect such patient health care usages as the IHS patient summaries, and this usage represents about 10 percent. Thus, a total of at least 91 percent of all terminal usage can be attributed directly to patient health care. The remaining 9 percent is primarily devoted to Equipment Records data base usage and checkout.

3.7 POWER EQUIPMENT USAGE

Power equipment (generators) are used at the HSSCC, LHSC, QRS, and in the MHU. Total usage time is recorded by running the meters on the MHU, LHSC, and HSSCC equipment and by telemetry recording at QRS.

The Sells Hospital generator operates as a backup to the utility power. During power variations from the utility supply, the Uninterruptible Power System (UPS) maintains a stable source of power. The UPS has operated successfully during every power outage and provided a significant improvement in the computer operation time.

LHSC propane (LPG) generator is used only in emergency when the main utility power shuts down. There has not been a reported emergency incidence where this was required. The generator is exercised once a week for 15 minutes during routine maintenance checks (18 hours over a 6-month period). An incinerator has been installed at the LHSC to burn infectious waste. This installation involved tying into the LPG line leading from the tank to the 55 KW standby generator. A routine weekly check on the tank's capacity is carried out.

QRS auxiliary generators (diesel and the LPG) were overhauled during this period. The overhauls were programmed maintenance.

MHU auxiliary generator in the vehicle as well as the trailer generator are operating satisfactorily, requiring only preventive and routine maintenance.

Section 4

HARDWARE EVALUATION RESULTS

4.1 UTILIZATION AND PERFORMANCE OF SYSTEM EQUIPMENT

The utilization of system equipment with emphasis on monthly trends, failure rates, high/low usage, and ratios between medical use and communication for other purposes (not related directly to medical) has been analyzed and is presented in summary form.

Three major data sources were available for analyzing and determining the utilization and performance of the system equipment: (1) The Telecommunication Equipment (TCE) usage log (contains performance data on 24 TCE types -- see Table 4-1), (2) Usage Data on equipment at QRS, MHU Vehicle, Computer, and Supporting Peripheral Equipment, and Power Equipment, and (3) STATS - On-Line Terminal Statistics Program report on the computer software/terminal usage.

Monthly data are presented covering the current 6 months and are compared to the first 6 months, and the overall one and one-half year. One and one-half year totals are also given on a month-to-month basis for an overview of the operation from start to the end of this reporting period.

Telecommunications are defined in accordance with the purposes that they serve. Engineering telecommunications are concerned with checkout, troubleshooting, communications (between engineering personnel and/or engineering personnel and health care personnel), and control signal transmissions. Medical telecommunications are concerned with contacts between the CHM/Physician and Medical and Administration personnel. Teleconsultations contacts are specific medical communications between the CHM and the Physician.

Table 4-1

GLOSSARY OF TELECOMMUNICATION EQUIPMENT TERMS

Telecommunication Equipment Type	Description
Color TV, Patient View	Patient viewing color TV system which includes the camera, monitor, and local camera control unit.
Color TV, Patient View Microscope	Surgical microscope for endoscopic examination which includes color camera, fiberoptics viewing bundle, light-source microscope, and ceiling-mounted track.
Color TV, Lab Microscope	Laboratory microscope which includes binocular microscope, light source, light filters, camera adapter, and color TV camera.
Black and White TV, X-Ray	Black and white X-ray viewing system which includes black and white TV camera, X-ray viewer, local camera control unit, and camera mount.
Black and White TV, Physician (HSSCC)	Black and white camera in physician's console used to transmit the physician's image for viewing by the patient at the remote facility.
Black and White TV, Slo-Scan (HSSCC)	Black and white camera located near the physician's console used to transmit X-ray images as part of the slo-scan system. Includes black and white TV camera, mount, X-ray viewer, and local camera control.
Handsfree, MUX	The handsfree intercom used for communication between the remote facility and HSSCC. Includes intercom units and audio multiplexer unit.
Handsfree, TV	The TV handsfree intercom generally used as backup for the MUX handsfree intercom.
Privacy, Audio, Remote	The privacy audio channel used for private conversations between CHM and the Physician. Includes the CHM hand/headset at the remote facility.
Hotline	The hotline is the communication link between the Operator's Console, and the CHM is the link in a remote facility. When one handset is removed from its cradle, the unit at the other end rings until it is answered.
VHF	The VHF radio system used when the MHU is enroute or the microwave system is not operational.
Order Wire	A special audio channel within the microwave system used primarily for maintenance and troubleshooting.

Table 4-1 (Cont'd)

Telecommunication Equipment Type	Description
Telemetry (QRS)	The control and telemetry system used to remotely control the QRS Relay Station from HSSCC.
ECG	The Cardiostat T single-channel electrocardiogram unit including the transmitter (oscillator).
Heart Sounds	The "Tonoscope" or battery-powered stethoscope used primarily to transmit heart sounds.
VTR	The Video Tape Recorder located in the communications rack (HSSCC) used to record incoming video from a remote facility or local from the Physician's Room.
Audio/Instrumentation Recorder	The audio recorder located in the communication rack (HSSCC) used to make audio recordings and to record ECG's.
Slo-Scan	The Slo-Scan units at HSSCC and PRC used to transmit/receive X-ray images, photographic, and graphical data.
Color Camera Phy (HSSCC)	Color camera in Physician's Room to record color image of patients, etc., primarily from Slo-Scan transmission.
PAM	Portable Ambulance Module (MHU and Sells Emergency Room).
Telecoupler	The telephone acoustical coupler located at the Physician's Console used to patch the handsfree intercom into the dial telephone for calling the lab, medical records, etc.
Telemetry Remote Camera Control	The Remote Camera Control Units located at both the Operator's and Physician's Console at HSSCC used to remotely control TV cameras at either remote facility.
PRC Camera	B&W Camera installed in the Phoenix Indian Medical Center. Used for transmittal of images to Sells via Slow-Scan TV.
Community TV and Audio	HSSCC consoles equipped to transmit community/educational video to the MHU which displays it on externally located monitors.

4.1.1 Medical Telecommunications/Teleconsultation Contacts (CHM/Physician and MED/Administration)

The use of the STARPAHC system by the health care personnel is presented in Table 4-2, which summarizes the total activities over the third 6-month period and gives a comparison between total Telecommunications, Medical Telecommunications, and Teleconsultation contacts. The most significant factor is the monthly increase of the medical telecommunications for 4 months (June through September); equally important is that medical use accounted for 62.28 percent of the total Telecommunications. (Teleconsultation contacts accounted for 32.58 percent, while transmissions between MED/Administration accounted for 29.70 percent). The increase in teleconsultation contacts over MED/Administration is a reversal of the trend observed in the first year and indicates that there is more participation between the CHM/Physician as experienced with the system increases.

The monthly fluctuations in the use of medical telecommunications is attributed to several factors. CHM's Evelyn Tom and Angelita Williams replaced CHM's Ken Tiokasin and LPN Susan Trama on the MHU June 16, 1976. The relatively inexperienced replacement team found the need to communicate with the Sells Physician on a more frequent basis. The two MHU CHM's were subsequently monitored by Ken Tiokasin who was stationed at Sells, which further affected the number of telecommunications. Other factors that affected the number of telecommunications were the 2-day and the one 4-day out-of-service periods for the MHU.

4.1.2 Telecommunication Usage Analysis

Table 4-3 summarizes, on a monthly basis, the usage in terms of Use, Quality, and Purpose for the first year of operation. Table 4-4 summarizes on a monthly basis, the third 6-months usage. Comparison on a month-to-month basis (May 1975 vs May 1976) one sees that fluctuations in the number of telecommunications do not correspond on a monthly basis.

Table 4-2

**TOTAL TELECOMMUNICATION/MEDICAL
TELECOMMUNICATION COMPARISON**

Month 1976	Total Telecommunications	Medical Telecommunications	
		Chm/Phys.	Med/Admin.
May	256	67	72
June	438	129	140
July	325	135	91
August	287	133	74
September	287	113	63
October	279	33	116
TOTALS	1,872	610 ^(a)	556
		(1,166) Medical Use	

(a) Teleconsultation Contacts

Table 4-3

TCE USAGE BOX SCORE/MONTH

Period: 01 May 1975 through 30 April 1976

	Use			Quality					Purpose					
	Try	Fail	PAR ^(a)	Exc.	Good	Fair	Poor	Fail	C/O	Trbl-shoot	Comm.	Cont.	Chm/Phy.	Med/Adm.
May 1975	216	4	98.15 ^(a) 96.76 ^(b)	1	208	2	1	4	9	2	57	17	37	94
June 1975	240	4	98.33 93.33	2	222	9	3	4	25	4	110	5	27	69
July 1975	342	6	98.25 88.89	8	296	25	7	6	40	1	119	32	64	86
August 1975	465	6	98.71 84.73	5	389	44	21	6	51	7	113	58	145	91
September 1975	484	14	97.11 94.83	16	443	9	2	14	33	12	132	42	138	127
October 1975	229	9	96.07 90.39	1	206	6	7	9	19	0	80	40	62	28
November 1975	275	3	98.91 94.55	0	260	11	1	3	10	5	90	32	78	60
December 1975	308	5	98.38 86.36	0	266	26	11	5	31	2	81	33	63	98
January 1976	359	6	98.333 87.19	0	313	32	8	6	6	0	83	27	106	137
February 1976	269	4	98.51 86.99	0	234	21	10	4	16	1	61	27	45	119
March 1976	386	7	98.19 86.01	0	332	38	9	7	32	3	54	23	88	186
April 1976	425	8	98.12 92.00	3	388	21	5	8	26	1	89	46	150	113
Annual Totals	3,998	76	98.10 ^(a) 89.87 ^(b)	36	3,557	244	85	76	298	38	1,069	382	1,003	1,208

(a) Gross PAR

(b) Net PAR

Table 4-4
TCE USAGE BOX SCORE/MONTH

Period: 1 May 1976 through 31 October 1976

	Use			Quality					Purpose					
	Try	Fail	PAR ^(a)	Exc.	Good	Fair	Poor	Fail	C/O	Trbl-shoot	Comm.	Cont.	Chm/Phy.	Med/Adm.
May 1976	256	2	99.21 ^(a) 92.96 ^(b)	0	238	10	6	2	23	0	69	25	67	72
June 1976	438	5	98.85 90.63	2	395	34	2	5	22	0	106	41	129	140
July 1976	325	5	98.46 87.07	2	283	30	5	5	15	1	57	26	135	91
August 1976	287	0	100.00 97.21	0	279	6	2	0	7	0	56	17	133	74
September 1976	287	6	97.90 92.68	3	263	13	2	6	14	0	77	20	113	63
October 1976	279	1	99.64 94.26	0	263	14	1	1	7	0	107	16	33	116
Third 6-month Totals	1,872	19	98.98 ^(a) 92.30 ^(b)	7	1,721	107	18	19	88	1	472	145	610	556

(a) Gross PAR

(b) Net PAR

Variations are primarily random and are associated with personnel assignments/locations, availability of the equipment, and unique situations, e.g., immunization requirement increases. Table 4-5 shows the usage by TCE type for the last six months of operation. Table 4-6 shows the usage by TCE type for the 1st year of operation. Comparison on a month-to-month basis, one sees that the most used TCE during the first year repeated itself in the third 6-months. The TCE list used during the first year of operation was modified for the third 6-month period to reflect the addition of a color camera at the HSSCC and a B&W camera at PRC for slow-scan TV, and the community TV and audio capability added between the HSSCC and the MHU.

These tables are significant because the use data portray the continued high monthly number of telecommunication transmissions (312 monthly average compared to prior year monthly average of 333), the low monthly failure rate (3 monthly average compared to prior year monthly average of 6), and the resultant High Performance Acceptability Ratio (PAR). The quality of transmission remains predominantly good. Medical use accounts for over 60% of the total telecommunications.

Number of Telecommunications. Figure 4-1 presents a summary of one and one-half years telecommunications on a month-by-month basis. Average monthly telecommunications for the first 6-months (May-Oct. 1975) were 329, for the second 6 months (Nov. 1975-April 1976) were 337, and for the third 6 months (May-Oct. 1976) were 312. High and low variations between the three 6-month periods showed fairly good correlation although the high number of telecommunications in the first 6-months occurred in the August-September time period, while the third 6-month high occurred in June. The lowest number of telecommunications occurred in the first month of operation (216 - May 1975). This is attributed to the startup nature of the program. Lowest number of the second 6-month period occurred in February 1976 (269), attributed to an influenza epidemic that curtailed teleconsultations. Lowest number of the third 6-month period occurred in May 1976 (256), attributed to having the most experienced personnel assigned to the MHU and to shorter monthly work periods (16 days vs 18 days).

Table 4-5

USAGE TABULATION/TCE TYPE

Period: 01 May 1976 through 31 October 1976

	Use			Quality					Purpose					
	Try	Fail	PAR ^(a) (%)	Exc.	Good	Fair	Poor	Fail	C/O	Trbl- shoot	Comm.	Cont.	Chm/ Phy.	Med/ Adm.
01 Color TV, Pat View	145	0	100.00	1	114	27	3	0	23	0	1	1	114	7
02 Color TV, Pat View Mic	1	0	100.00	0	0	1	0	0	0	0	0	0	1	0
03 Color TV, Lab Mic	7	1	85.71	0	6	0	0	1	5	0	2	0	0	0
04 B&W TV, X-Ray	25	0	100.00	0	22	3	0	0	7	0	3	0	15	0
05 B&W TV, Phy (HSSCC)	132	0	100.00	0	129	3	0	0	8	0	2	0	88	34
06 B&W TV, Phy X-Ray (HSSCC)	0	0	—	0	0	0	0	0	0	0	0	0	0	0
07 Handsfree, MUX	335	2	99.40	1	297	32	3	2	7	0	41	0	143	144
08 Handsfree, TV	7	0	100.00	0	7	0	0	0	2	0	1	0	0	4
09 Privacy Audio (Remote)	113	2	98.23	0	107	1	3	2	1	0	27	0	20	65
10 Hotline	528	6	98.86	0	519	3	0	6	2	0	179	0	131	216
11 VHF	154	0	100.00	1	141	9	3	0	1	0	141	0	2	10
12 Orderwire	31	0	100.00	0	31	0	0	0	0	1	30	0	0	0
13 Telemetry (QRS)	127	1	99.21	0	122	3	1	1	0	0	2	124	1	0
14 ECG	2	0	100.00	0	1	1	0	0	1	0	0	0	1	0
15 Heartsounds	5	2	60.00	0	2	1	0	1	4	0	00	0	1	0
16 VTR	15	0	100.00	0	6	9	0	0	4	0	4	0	3	4
17 A/I Recorder	1	0	100.00	0	1	0	0	0	1	0	0	0	0	0
18 Slo-Scan, X-Ray & Data ^(c)	32	1	96.87	0	23	8	0	1	17	0	6	1	5	3
19 Color Camera, Phy (HSSCC) ^(c)	1	0	100.00	0	1	0	0	0	1	0	0	0	0	0
20 PAM	0	0	—	0	0	0	0	0	0	0	0	0	0	0
21 Tel-Cplr	120	3	97.50	4	108	3	2	3	1	0	32	0	21	66
22 Telemetry Remote CC	90	1	98.88	0	83	3	3	1	2	0	0	21	64	3
23 PRC Camera	0	0	—	0	0	0	0	0	0	0	0	0	0	0
24 Community TV & Audio	1	0	100.00	0	1	0	0	0	1	0	0	0	0	0
Totals	1,872	19	98.98 ^(a) 92.30 ^(b)	7	1,721	107	18	19	88	1	472	145	610	556

(a) Performance Acceptability Ratio (Gross)

(b) Performance Acceptability Ratio (Net)

(c) NEC slo-scan receiver and camera installed during this period.

Table 4-6

USAGE TABULATION/TCE TYPE

Period: 01 May 1975 through 30 April 1976

	Use			Quality					Purpose					
	Try	Fail	PAR ^(a) (%)	Exc.	Good	Fair	Poor	Fail	C/O	Trbl- shoot	Comm.	Cont.	Chm/ Phy.	Med/ Adm.
01 Color TV, Pat View	369	15	95.93	8	265	60	22	15	133	3	11	1	193	28
02 Color TV, Pat View Mic	17	2	88.23	0	9	3	3	2	9	1	0	0	7	0
03 Color TV, Lab Mic	29	3	89.65	1	19	4	2	3	20	2	1	0	5	1
04 B&W TV, X-Ray	58	4	93.10	0	46	4	4	4	25	0	1	0	31	1
05 B&W TV, Phy (HSSCC)	335	4	98.80	0	323	6	2	4	21	0	9	0	145	160
06 B&W TV, Phy X-Ray HSSCC	0	0	—	0	0	0	0	0	0	0	0	0	0	0
07 Handsfree, MUX	721	10	98.61	6	620	69	16	10	17	4	65	0	262	373
08 Handsfree, TV	12	2	83.33	0	9	0	1	2	3	1	1	0	4	3
09 Privacy, Aud, Remote	165	1	99.39	5	128	26	5	1	3	0	15	0	52	95
10 Hotline	1,112	10	99.10	5	1,085	10	2	10	13	9	515	0	181	397
11 VHF	385	4	98.96	3	360	10	8	4	3	8	338	0	2	34
12 Orderwire	77	2	97.40	0	74	0	1	2	1	3	72	0	0	1
13 Telemetry (QRS)	337	2	99.40	4	327	1	3	2	3	2	23	306	3	0
14 ECG	6	0	100.00	0	4	2	0	0	3	0	0	1	2	0
15 Heartsounds	14	1	92.85	0	6	3	4	1	4	2	0	0	8	0
16 VTR	33	3	90.90	1	22	2	5	3	3	0	0	0	16	24
17 A/I Recorder	1	0	100.00	0	1	0	0	0	1	0	0	0	0	0
18 Slo-Scan (X-Ray) ^(b)	26	0	100.00	0	18	8	0	0	13	0	1	0	9	3
19 Slo-Scan (Data) ^(b)	14	1	92.85	1	10	2	0	1	10	0	1	0	1	2
20 PAM	0	0	—	0	0	0	0	0	0	0	0	0	0	0
21 Tel-Cplr	149	2	98.65	0	111	32	4	2	0	0	16	0	41	92
22 Telemetry Remote CC	138	10	92.75	2	120	2	3	10	13	3	3	74	41	4
Annual Totals	3,998	76	98.09 89.88	36	3,557	224	85	76	298	38	1,069	382	1,003	1,208

(a) PAR — Performance Acceptability Ratio

(b) Infotechnics slo-scan equipment being evaluated

(ONE AND ONE-HALF YEAR DATA)

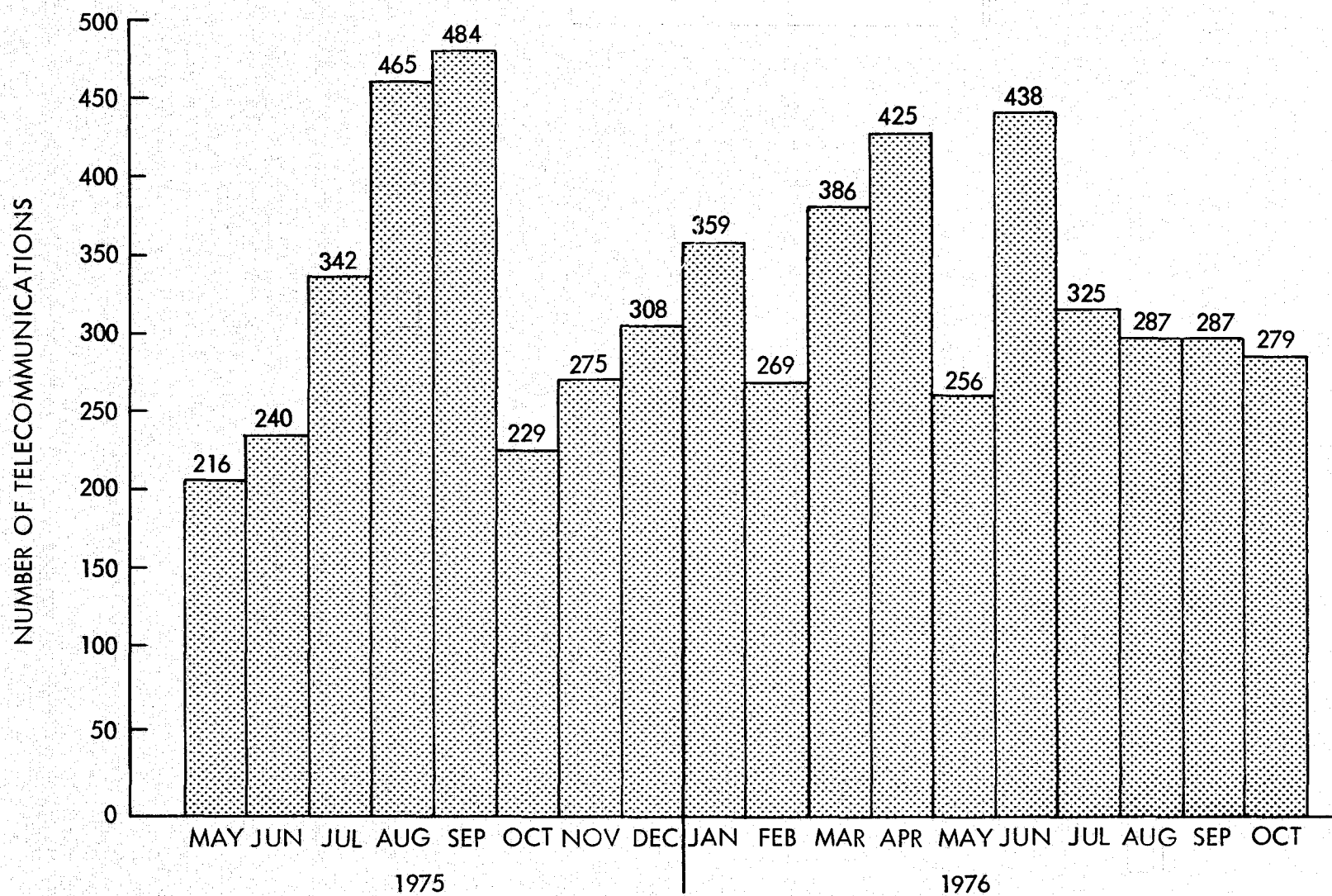


Fig. 4-1 Telecommunications Month-to-Month
(One and One-Half Year Data)

Checking the maximum difference in telecommunications between any two months during the first, second, and third 6-months shows a difference of 268, 156, and 182, respectively. Checking the maximum difference in telecommunications between each preceding month for the three 6-month periods shows a difference of 255, 117, and 182, respectively. The larger difference in the first 6-months was interpreted as due to the shakedown factor, whereas the second 6-months smaller differences were demonstrating a more stable period with differences in monthly telecommunications smoothing out. The third 6-month differences varied widely in the first 2 months of that period (May-June); however, after that, the differences were considerably less. The large difference in the first 2 months is attributed to the relatively inexperienced health care personnel assigned to the MHU in June.

Performance Acceptability Ratio (PAR). The PARs are listed in Tables 4-3 through 4-6 for each month and for each of the TCE types. In assessing the percent of success as a ratio of the number of failures to the number of transmission (gross PAR) for the third 6-months as compared to the first year of operation, shows 99.01 percent to 97.77 percent, respectively. The percent of success as a ratio of the total number of failures, poor, and fair to the number of transmissions (net PAR) for the third 6-months as compared to the first year of operation shows 92.46 percent to 91.48 percent. Reviewing each month's PAR for the third 6-months shows the maximum percentage difference between any month was 4 percent, which compares favorably with the 3 percent difference recorded during the first year of operation.

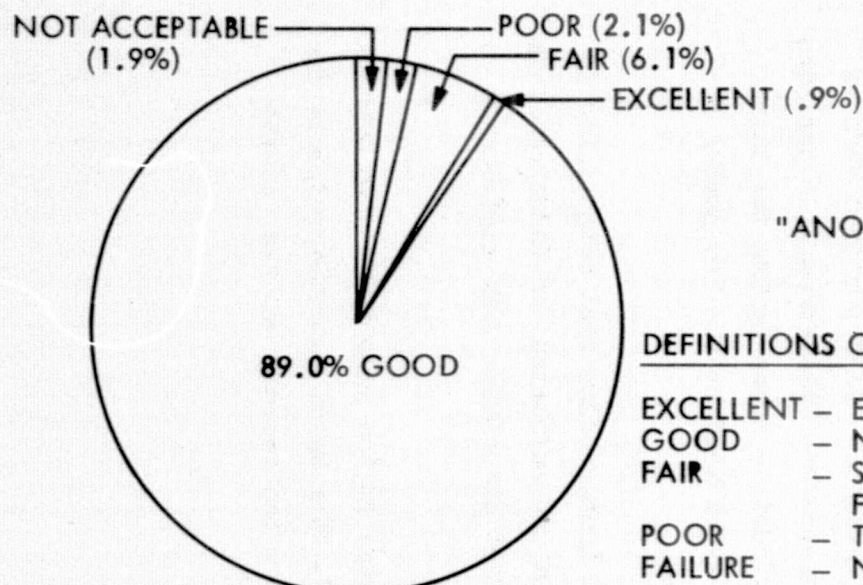
Quality of Transmission. During the third 6-months, there were 1728 transmissions of Excellent/Good quality out of a total of 1872 telecommunications, or a net PAR of 92.30 percent. Excellent ratings were reserved for video transmission with excellent contacts and observations of minute detail. The reduction in that quality rating noted in the second 6-months has continued during the third 6-months which is attributed to the operator's critical judgment. The number of excellent quality ratings experienced during the third 6 months is very close to those obtained during the second 6-months operation, 7 compared to 3. A summary of the distribution of quality ratings during the

first year of operation compared to the third 6 months is illustrated in Fig. 4-2. The quality ratings are not significantly different for the two periods except for the increase in Quality, Good, and 50% reduction in Failures. For a one and one-half year assessment of the quality of telecommunications, Fig. 4-2 shows that the Good quality is by far the largest percentage (89.0% for the first year and 92% for the third 6 months), with Fair at 6% and 6%, respectively, and the remaining three quality ratings, Poor, Not Acceptable, and Excellent, making up the small balance of percentage remaining.

Purpose of Telecommunications. Six categories (Tables 4-3 and 4-4) were established to determine the specific purpose of each transmission over the one and one-half years period of operation. Fig. 4-3 shows the percentage breakdown for the purpose of the telecommunications for the third 6-months as compared to the one and one-half years of operation. During the third 6-months, medical purpose use accounted for 62.3% as compared to 57.5% for the one and one-half years of operation. Other purposes such as communication and control showed slight changes over the comparable periods. Checkout/Troubleshooting reflects a significant decrease during the third 6-months (4.8% compared to 7.2%) which is attributed to the low number of failures experienced in the third 6 months.

Usage Time Analysis. The trend of reduced transmission time established in the second 6-months over the first 6-months was maintained as illustrated in Fig. 4-4, which shows the monthly time spread associated with engineering or medical purposes.

Engineering time shows a significant decrease in the second 6-months over the first 6-months (145:42 compared to 288:18). The third 6-months reflects the same trend; however, it was slightly up over the second 6-months (164:54 compared to 145:42).

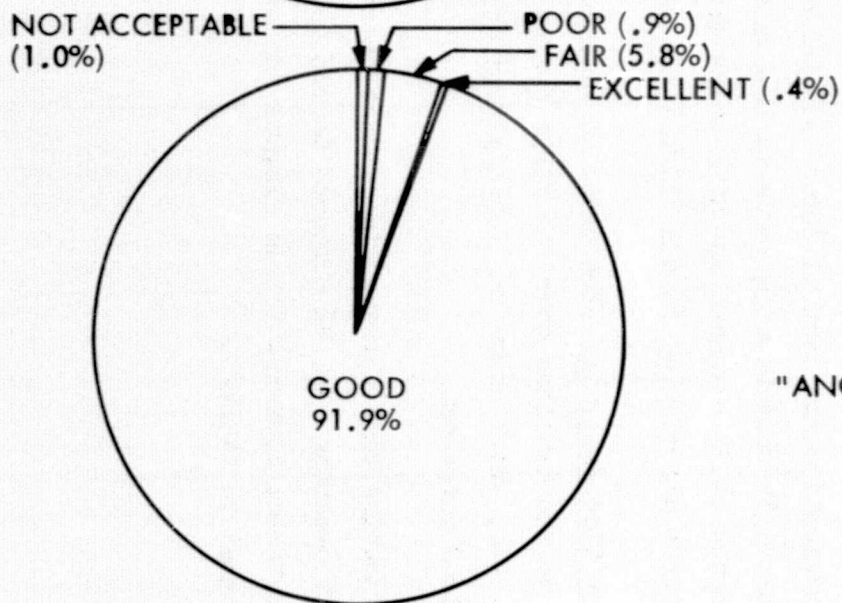


DEFINITIONS OF QUALITY

- EXCELLENT - EXCELLENT CONTRASTS; MINUTE DETAIL OBSERVED.
 GOOD - NOISE PRESENT; NO PRACTICAL DEGRADATION.
 FAIR - SOME DEGRADATION; NOISY BACKGROUND, BUT FULLY HEARD AND SEEN.
 POOR - TRANSMISSION; BUT STRAINING TO SEE AND HEAR.
 FAILURE - NO TRANSMISSION; NOT ACCEPTABLE.

MAY 1975 THROUGH APRIL 1976

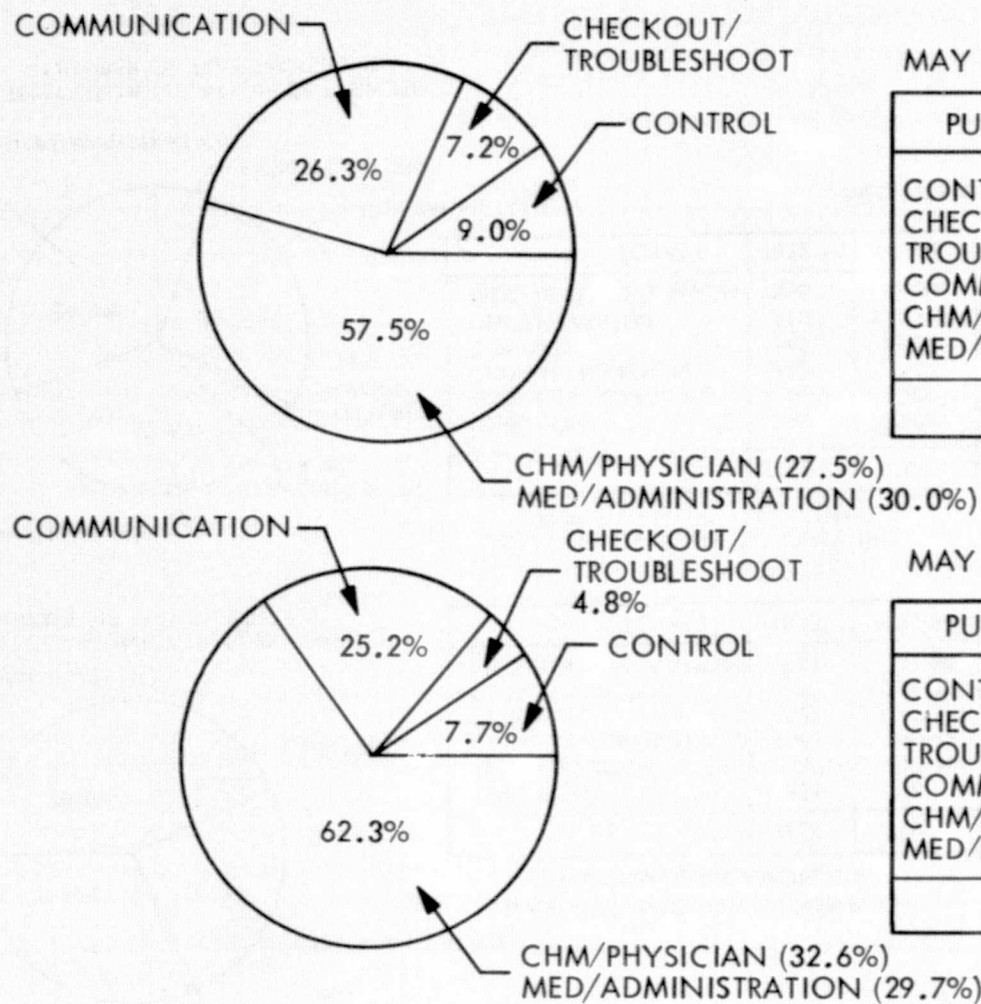
QUALITY	TELECOMMUNICATIONS
EXCELLENT	36
GOOD	3557
FAIR	244
POOR	85
NOT ACCEPTABLE	76
TOTAL	3998



MAY 1976 THROUGH OCTOBER 1976

QUALITY	TELECOMMUNICATIONS
EXCELLENT	7
GOOD	1721
FAIR	107
POOR	18
NOT ACCEPTABLE	19
TOTAL	1872

Fig. 4-2 Quality of Transmission (Third 6-Months vs First Year of Operation)



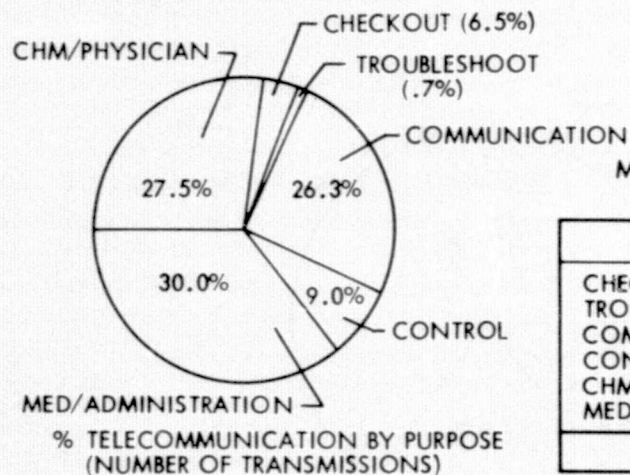
MAY 1975 THROUGH OCTOBER 1976

PURPOSE	TELECOMMUNICATIONS
CONTROL	527
CHECKOUT	386
TROUBLESHOOT	39
COMMUNICATION	1541
CHM/PHYSICIAN	1613
MED/ADMINISTRATION	1764
TOTAL	5870

MAY 1976 THROUGH OCTOBER 1976

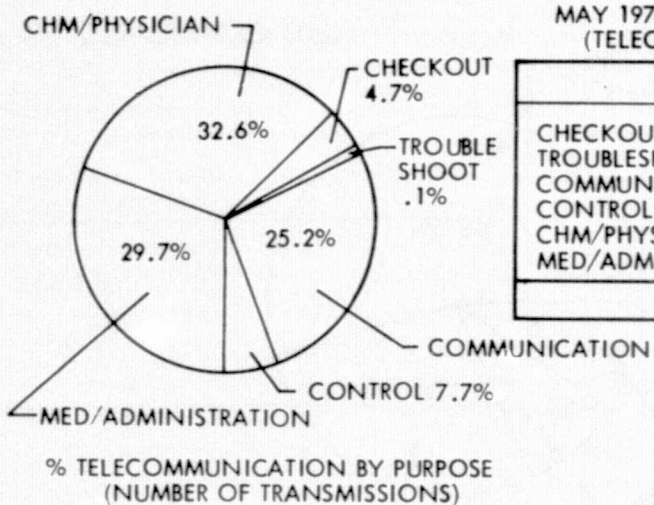
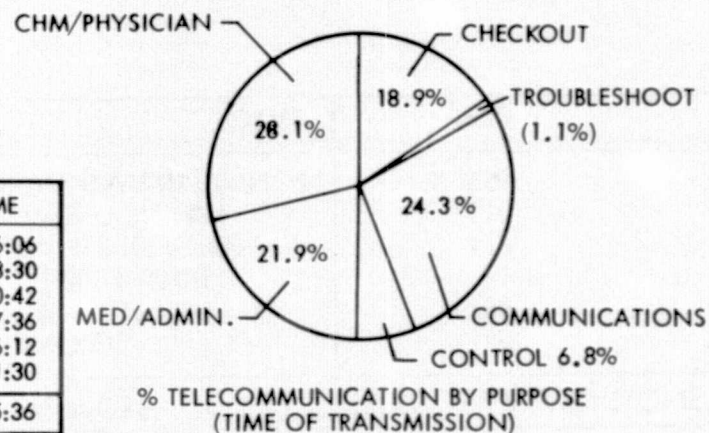
PURPOSE	TELECOMMUNICATIONS
CONTROL	145
CHECKOUT	88
TROUBLESHOOT	1
COMMUNICATION	472
CHM/PHYSICIAN	610
MED/ADMINISTRATION	556
TOTAL	1872

Fig. 4-3 Purpose of Transmission (Third 6-Months vs 18-Months of Operation)



MAY 1975 THROUGH OCTOBER 1976
(TELECOMMUNICATION/TIME)

	TELE	TIME
CHECKOUT	386	226:06
TROUBLESHOOT	39	13:30
COMMUNICATION	1541	290:42
CONTROL	527	67:36
CHM/PHYSICIAN	1613	336:12
MED/ADMINISTRATION	1764	261:30
TOTALS	5870	1195:36



MAY 1976 THROUGH OCTOBER 1976
(TELECOMMUNICATION/TIME)

	TELE	TIME
CHECKOUT	88	70:00
TROUBLESHOOT	1	:06
COMMUNICATION	472	77:54
CONTROL	145	16:54
CHM/PHYSICIAN	610	111:42
MED/ADMINISTRATION	556	63:30
TOTALS	1872	340:06

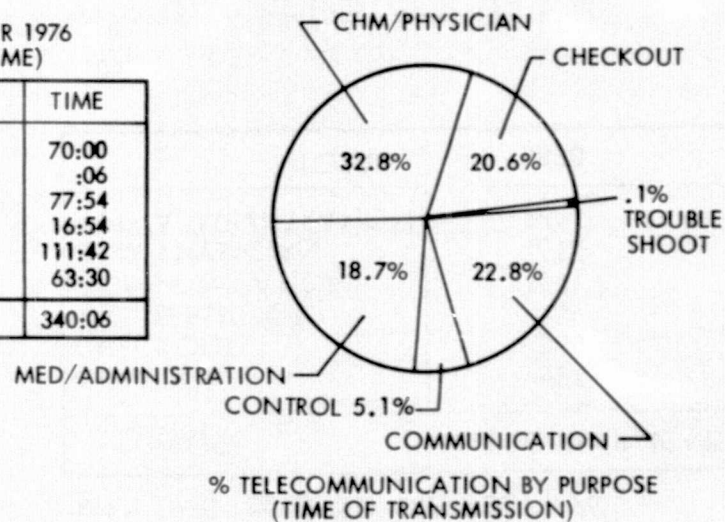


Fig. 4-4 Percent of Telecommunications by Purpose
(Number/Time for 18-Months vs Third 6-Month Period)

Medical time shows a continuing decrease in each 6-month period (229:36, 191:54, and 175:12, respectively for the three 6-month periods). It is interesting to note that medical/engineering times are practically equal for the third 6-months, whereas at the beginning of operation, engineering time exceeded medical time significantly. The equalization is attributed to less checkout and troubleshooting for engineering and greater participation between the CHM/Physician.

Figure 4-5 illustrates the elapsed time by Purpose in reference to the number of transmissions and the time of transmissions. Data for the 18-months of operation and the last third 6-months are shown. As noted in the two boxes on the figure, the total transmissions show little difference in the monthly average of 326 to 312 average transmissions per month (18-months vs third 6-months); however, the time varies from 1195:36 for 18-months or an average of 66 hours per month to 340:06 for the third 6-months or an average of 56.7 hours per month. It is equally significant that with the reduction in total transmission time, the average monthly transmission time for the CHM/Physician remains relatively the same (18.7 to 18.5 hours), even though there was a reduction in the total telecommunications and number of patient visits. This would indicate an increase in the CHM/Physician interparticipation.

4.2 RELIABILITY EVALUATION

4.2.1 Failures - Cause and Action Taken

The Trouble & Corrective Maintenance Report supports the Usage Log and is used to analyze degradation, failure rates, or trends. These data are entered daily by site personnel as problems occur and/or are reported. The data are used to:

- o Set work priority
- o Establish status of open items
- o Evaluate spares requirements
- o Analyze as part of the evaluation process

Subsequent text explores the criticality of failures as reported in the trouble reports with respect to health care delivery.

	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
ENGINEERING	55:20	74:00	36:06	48:30	44:06	30:18	17:12	28:36
MEDICAL	61:48	18:48	35:40	49:12	49:30	14:36	21:12	23:18

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL
13:30	25:12	34:36	26:36	47:36	32:18	30:18	19:42	18:42	16:18	598:54
33:12	19:36	40:42	53:54	19:42	38:36	35:42	34:42	26:18	20:12	596:42
TOTAL										1195:36

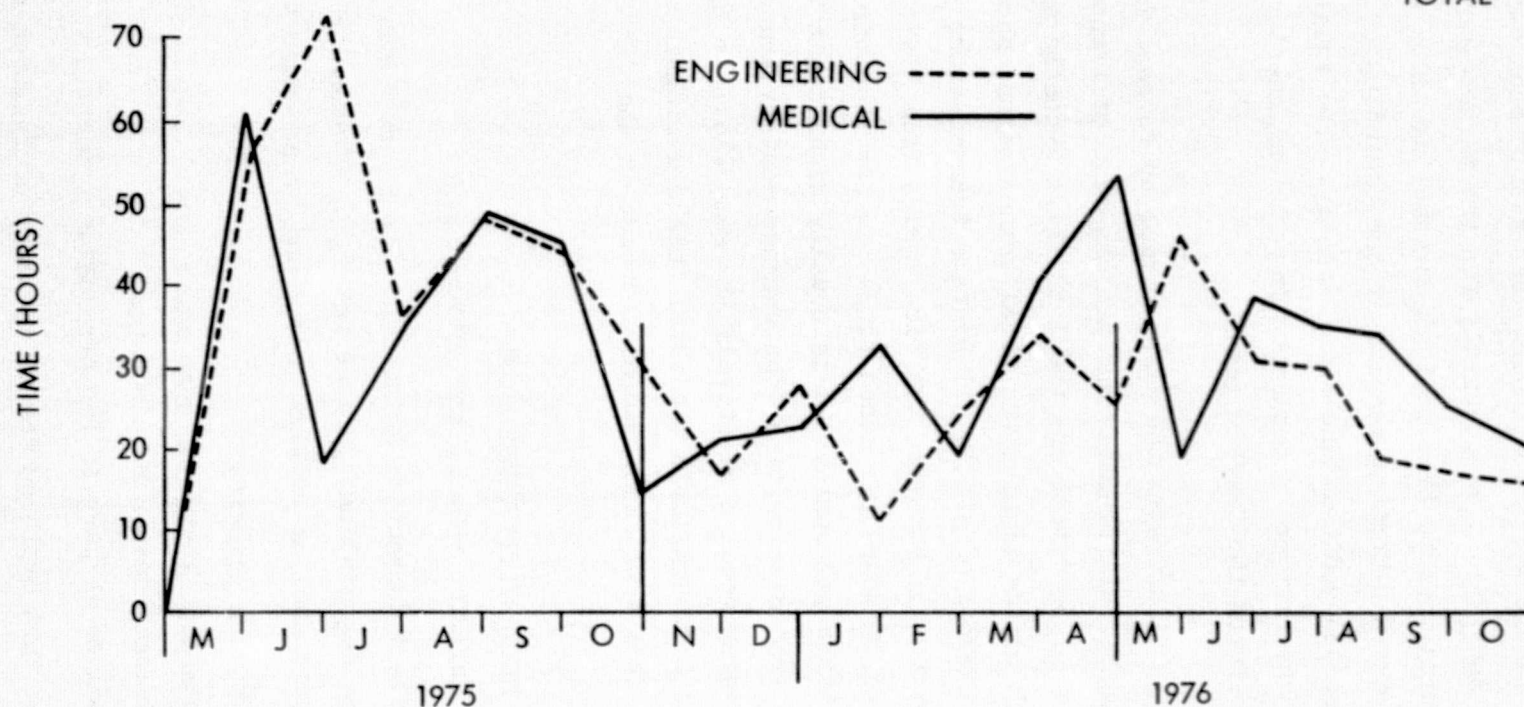


Fig. 4-5 Time Spread in General Telecommunications Purpose

4.2.2 Classification of Trouble Reports

Figure 4-6 illustrates the approach used to analyze the system problems. It considers the "cause" of the problem. Figure 4-6 also illustrates the trouble report analysis for the third 6-month period and compares it against the one and one-half years of operation.

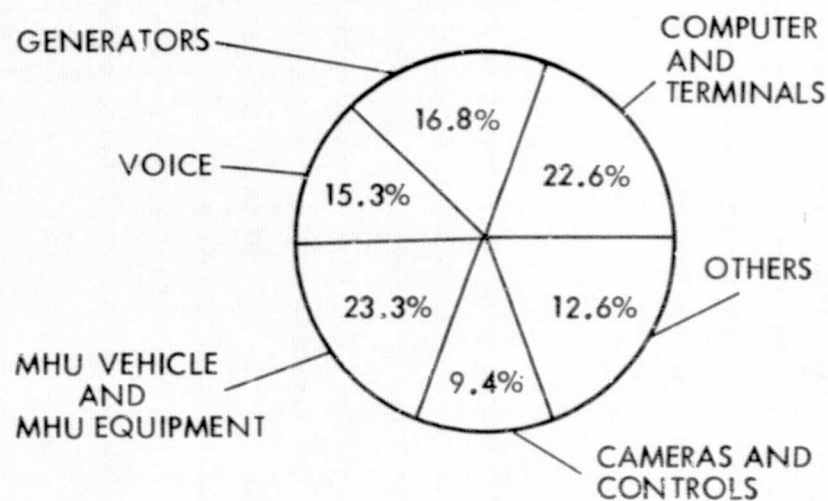
The average TRs/month for the third 6-months (23) is far below the average for the one and one-half years of operation. This is attributed to the improvement in power regulation caused by adding the UPS to the program. Operator's errors were reduced significantly in the third 6 months. This reflects an improvement in the learning curve and an improved familiarity with the equipment. The terminals, generators, and MHU vehicle and equipment provide the majority of failures. This equipment gets the most usage and the generators and the MHU are exposed to the environment, which accounts for a large proportion of their failures.

4.2.3 Failure Trend Analysis

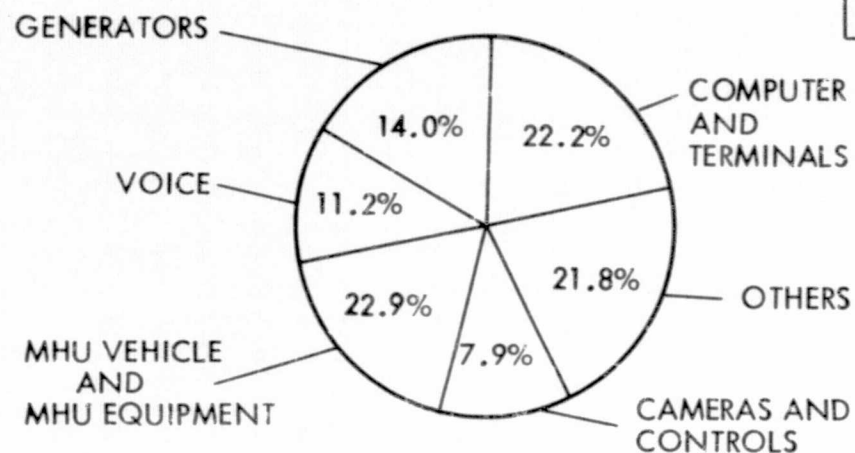
The categories of trouble reports are defined on Fig. 4-7. Fig. 4-7 also illustrates the trends of the incident classes over the three 6-month periods. The following section discusses each month of the third 6-month period and points out trends and results. Fig. 4-7 illustrates the decreasing number of failures during the third 6-months.

4.2.4 System Reliability

The TCE system reliability (defined as the probability of delivery of health care at any given time) of STARPAHC remains at a very impressive level of 98.4%. This figure is derived from trouble report logs and the raw usage log which indicate that from 1 May 1976 to October 30, 1976, only 19 "Not Acceptable" events occurred out of a possible 1872 events. In the 12-month period, beginning on May 1, 1975, the reliability of the system was 0.981. As noted in the previous reports, the TCE system reliability is actually higher because of redundant system capability, e.g., a "not acceptable" voice transmission via the Handsfree Intercom System is easily overcome by switching to either the Hotline or the VHF system(s).



MAY 1976 THRU OCT 1976



MAY 1975 THRU OCT. 1976

	MAY 1976 THRU OCT 1976	MAY 1975 THRU OCT. 1975
COMPUTER AND TERMINALS	31	129
MHU VEHICLE	13	63
MHU EQUIPMENT	19	70
GENERATORS (ALL)	23	81
VOICE	21	65
VIDEO	2	38
CAMERAS AND CONTROLS	13	46
OPERATOR ERRORS	4	25
ENVIRONMENTAL CONTROLS	—	16
QRS	7	19
MISC	4	28
TOTALS — TROUBLE REPORTS	137	580
AVERAGE PER MONTH	23	32

Figure 4-6 Distribution of Trouble Reports by Cause

INCIDENT CLASS	M	J	J	A	S	O	N	D	J	F	M	A	TOTAL	M	J	J	A	S	O	TOTAL
FAILURES	23	16	29	33	29	25	19	14	26	20	14	15	263	10	15	9	9	13	9	328
DEGRADATION	3	11	11	7	9	13	4	7	8	16	11	9	109	14	10	11	6	13	7	170
DEFICIENCIES	4	3	1	0	5	4	1	3	3	1	4	3	32	—	1	2	1	1	—	37
MODIFICATIONS	1	2	1	1	6	0	1	3	1	1	1	2	20	1	1	—	2	1	1	26
OTHER	0	1	2	2	1	0	2	4	2	1	2	2	19	—	—	—	—	—	—	19
TOTALS	31	33	44	43	50	42	27	31	40	39	32	31	443							580

1st PERIOD TOTAL = 243

2nd PERIOD TOTAL = 200

3rd PERIOD TOTAL = 137

DEFINITIONS OF INCIDENT CLASSES

FAILURES — EQUIPMENT MALFUNCTION CAUSING INTERRUPTION OF SERVICE.

DEGRADATION — REDUCTION OF PERFORMANCE; HOWEVER, EQUIPMENT MAINTAINS OPERATION.

DEFICIENCIES — NO REDUCTION OF PERFORMANCE; HOWEVER, IMPROVEMENTS OR MODIFICATIONS ARE RECOMMENDED.

MODIFICATIONS — CHANGES TO EQUIPMENT THAT RESULT IN IMPROVED PERFORMANCE.

*MODIFICATIONS AND OTHER NOT PLOTTED.

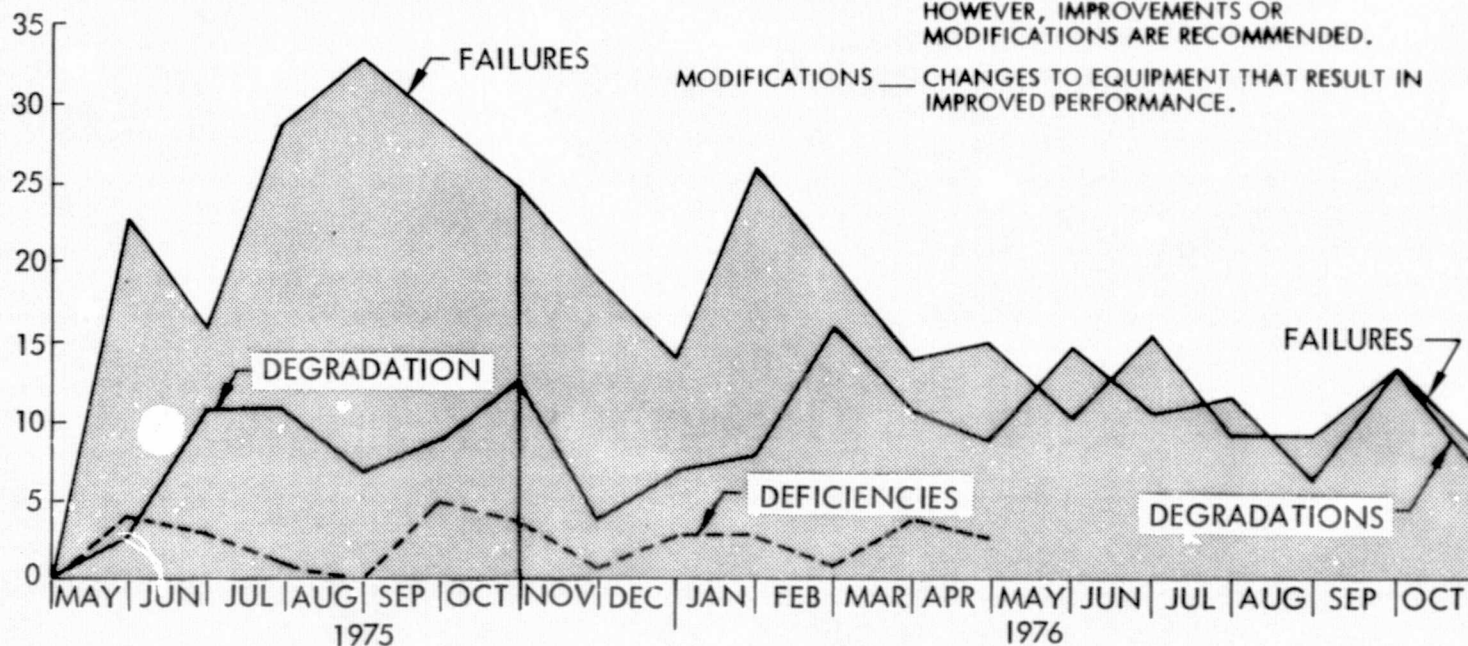


Fig. 4-7 Trouble Report Trend Analysis

Section 5

COST ANALYSIS

5.1 PROJECT STARPAHC COSTS

STARPAHC costs include the acquisition, maintenance, and operation of systems and equipment by Lockheed Missiles & Space Company, Inc., the primary contractor to NASA. Also included are the costs to the Indian Health Service of providing primary medical services and support at the Mobile Health Unit and the Santa Rosa Center Site and the cost of providing secondary/tertiary telemedicine services at the Sells Hospital and the Phoenix Referral Center. Minor direct support costs of NASA are also included. Specifically excluded from this cost analysis are the general costs of project planning, development, management, and evaluation as borne by NASA and IHS.

This presentation of STARPAHC costs includes:

Recurring Costs: for operations and maintenance, including labor, parts, expendables, subcontracts, utilities, and transportation.

Nonrecurring Costs: for (a) capital equipment, and (b) including engineering, labor, consumable, and installation costs.

Unit Costs: for outpatient visits and cost per hour of operation.

Mobile and Fixed Site Clinics: for comparison of the relative costs for each type clinic.

The period covered is May 1975 through October 1976.

5.2 RECURRING COSTS OF PROJECT STARPAHC OPERATIONS AND MAINTENANCE

The recurring operations and maintenance costs of the agencies involved in Project STARPAHC are described as follows. See Table 5-1 and Figure 5-1 for cost distribution by agency. Figure 5-2 gives cost distribution by agency for each month.

Indian Health Service's costs include medical support to the STARPAHC system, medical operation of a fixed base and mobile clinic, health records, pharmacy, lab, and x-ray services, transportation, maintenance of buildings and grounds, and related field administration. Labor costs include 3 full time positions for the MHU and six positions at Santa Rosa Clinic.

Lockheed site costs cover field operations and maintenance of the STARPAHC system hardware including the central control point at Sells, the Relay Station, the Mobile Unit, the fixed facility at Santa Rosa, and the Phoenix Indian Hospital referral site. Included are 4 full time position salaries for LMSC personnel.

Lockheed costs at Sunnyvale cover engineering support required to resolve field operational problems.

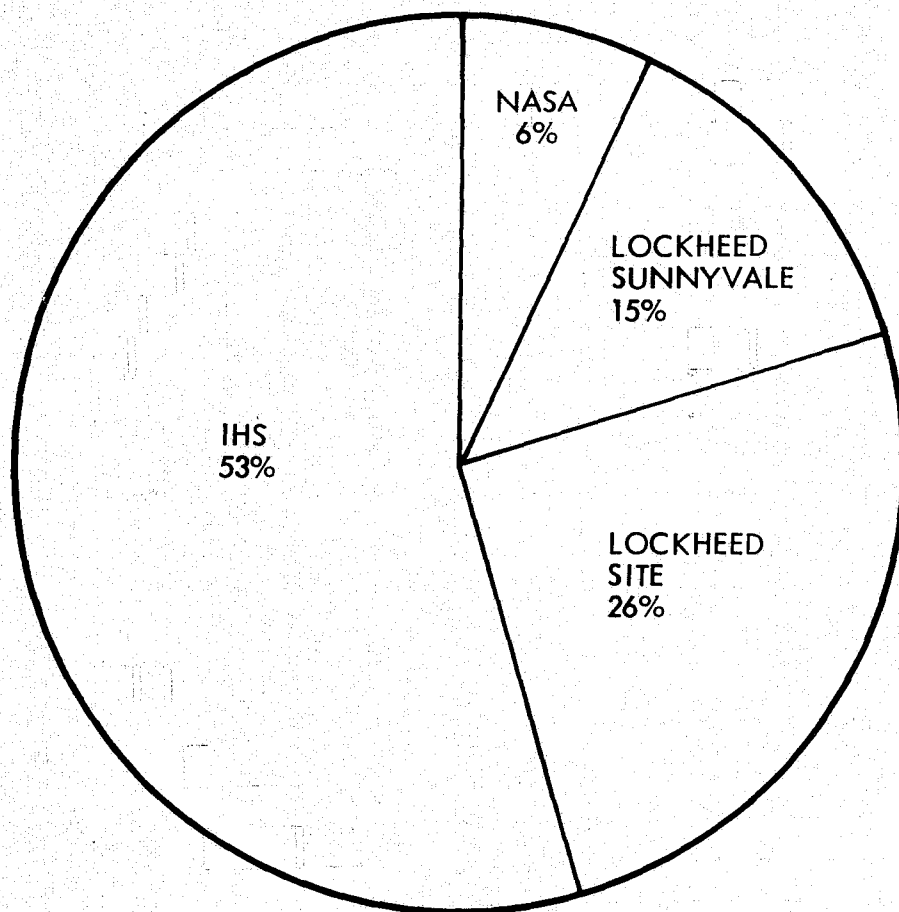
NASA costs include a maintenance contract for the Varian computer and the cost of vehicles furnished to Lockheed employees on the site.

Operations and maintenance costs are tracked monthly as incurred by each agency with details by major system element and by subsystems. Indian Health Service and Lockheed on-site operations and maintenance (O & M) costs show a gradual increase for materials and labor during the 18-month period. LMSC engineering support fluctuates with demand generated by equipment and support problems with a decrease in the second six-month interval and a like increase in the third period.

Table 5-1

RECURRING COSTS OF OPERATIONS AND MAINTENANCE
DISTRIBUTION BY MONTH AND BY AGENCY
18 MONTHS OF STARPAHC OPERATIONS
MAY 1975 - OCTOBER 1976

	Agency				
	<u>IHS</u>	<u>Site</u>	<u>Lockheed Sunnyvale</u>	<u>NASA</u>	<u>Total</u>
<u>1975</u>					
May	\$ 18,694	\$ 7,244	\$ 12,656	\$ 2,400	\$ 40,994
June	18,147	7,325	3,210	2,400	31,082
July	19,436	10,291	10,684	2,400	42,811
August	18,804	6,928	2,020	2,400	30,152
September	19,192	8,768	4,361	2,400	34,721
October	<u>18,431</u>	<u>11,432</u>	<u>2,731</u>	<u>2,400</u>	<u>34,994</u>
First 6-mo Total	\$112,704	\$ 51,988	\$ 35,662	\$14,400	\$214,754
November	\$ 18,952	\$ 11,839	\$ 4,305	\$ 2,400	\$ 37,496
December	18,342	8,537	3,711	2,400	32,990
1976 January	19,395	8,616	7,676	2,400	38,087
February	20,391	10,195	4,212	2,400	37,198
March	21,944	6,756	7,514	2,400	38,614
April	<u>19,898</u>	<u>9,593</u>	<u>5,208</u>	<u>2,400</u>	<u>37,099</u>
Second 6-mo Total	\$118,922	\$ 55,536	\$ 32,626	\$14,400	\$221,484
May	\$ 20,374	\$ 11,118	\$ 7,039	\$ 2,400	\$ 40,931
June	22,362	10,452	4,040	2,400	39,254
July	18,780	8,838	8,100	2,400	38,118
August	21,264	10,988	5,134	2,400	39,786
September	20,236	11,104	5,787	2,400	39,521
October	<u>20,235</u>	<u>13,935</u>	<u>5,893</u>	<u>2,400</u>	<u>42,463</u>
Third 6-mo Total	<u>\$123,251</u>	<u>\$ 66,435</u>	<u>\$ 35,993</u>	<u>\$14,400</u>	<u>\$240,079</u>
TOTAL	<u>\$354,877</u>	<u>\$173,959</u>	<u>\$104,281</u>	<u>\$43,200</u>	<u>\$676,317</u>

AGENCY

IHS	\$354,877
LOCKHEED SITE	173,959
LOCKHEED SUNNYVALE	104,281
NASA	43,200
TOTAL - 18 MONTHS	\$676,317

Fig. 5-1 Recurring Cost of Operations and Maintenance
(Distributed by Agency) - 18 Months of STARPAHC Operations

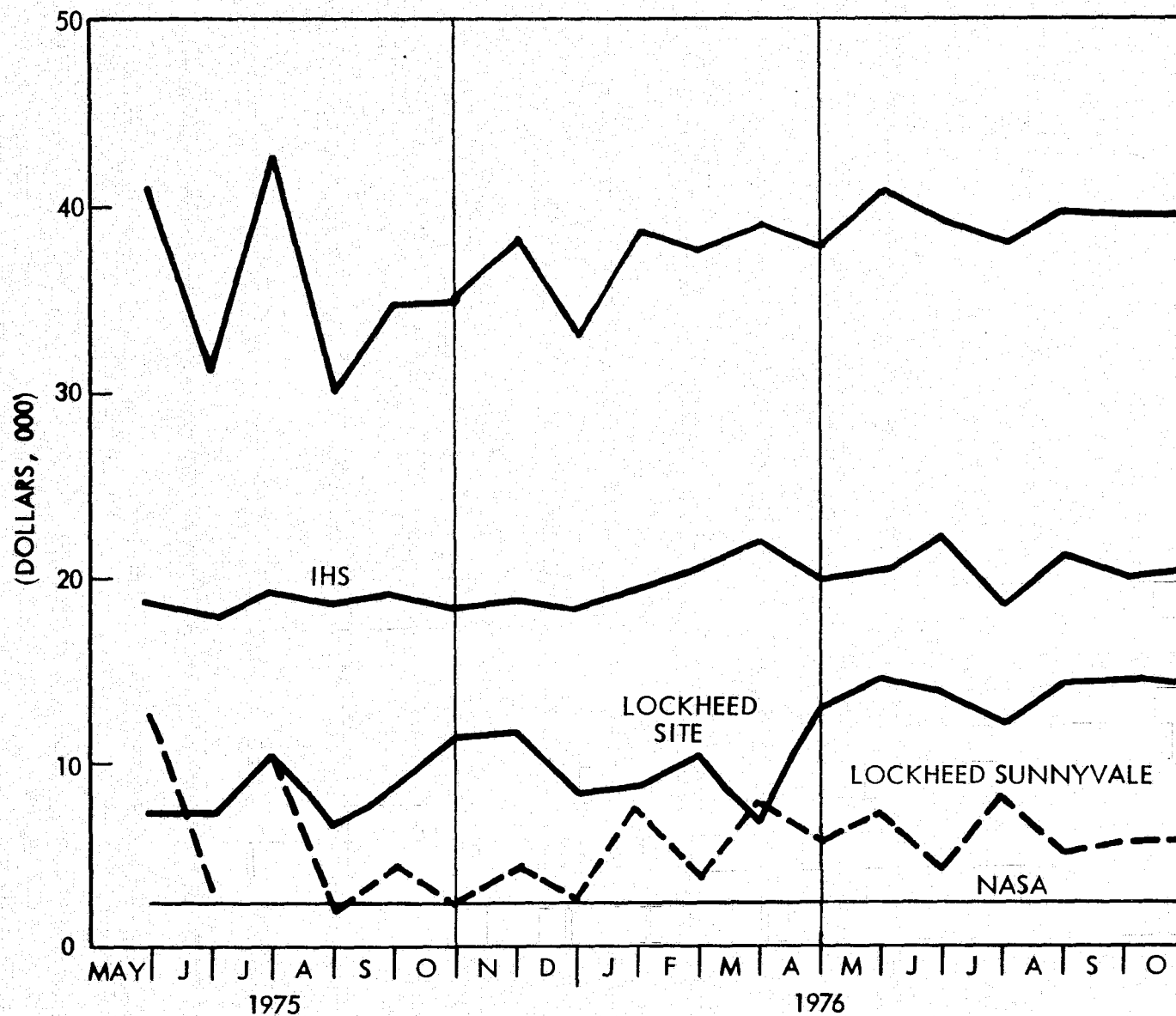


Fig. 5-2 Recurring Cost of Operations and Maintenance
(Distributed by Agency/Month)

5.3 NONRECURRING COSTS OF ACQUIRING PROJECT STARPAHC SYSTEMS

The nonrecurring costs incurred by the involved agencies in acquiring and installing Project STARPAHC systems and equipment are briefly described as follows. See Table 5-2 for cost distribution by agency and equipment system.

Indian Health Service (Department of Health, Education, and Welfare) costs include data terminals and improvements to buildings and site.

Lockheed and NASA nonrecurring STARPAHC costs include acquisition and installation of microwave two-way audio and video communications, VHF radio and telephone voice and data communications, real time medical data transmission systems, a computer data system, and recording and playback equipment. A control center is provided at Sells Hospital with a slow scan telephone link to the Referral Center and a VHF/Microwave link via a relay station to the Mobile Clinic and the Santa Rosa Center.

Excluded are design and development costs, mockups, site studies, and other non-specific project expenses.

Capital equipment costs and significant system improvements of the types described above are amortized over a ten-year period, without interest. Ten-year amortization has been chosen based on the anticipated life of major system equipments. Although equipment costs now appear firm, improvements during the first 18-months operations averaged \$3,000 monthly.

Table 5-2

NONRECURRING COSTS
 INSTALLED EQUIPMENT AND SYSTEM IMPROVEMENTS SHOWING AMORTIZATION RATES

	Installed Equipment (\$)	System Improvements (\$)	Total (\$)	Amortization Each 6 Months (\$)
<u>Indian Health Service</u>				
Data System	10,265	—	10,265	513
Building and Site Improvements	<u>40,729</u>	—	<u>40,729</u>	<u>2,037</u>
Total IHS	50,994	—	50,994	2,550
<u>Lockheed and NASA</u>				
VHF Radio	10,235	—	10,235	512
Color TV	205,014	—	205,014	10,250
B&W TV	112,159	—	112,159	5,608
MUX, TV Audio	130,031	—	130,031	6,502
Slo-Scan	72,363	—	72,363	3,618
Data System	163,366	43,394	206,760	10,338
Control System	29,079	1,032	30,111	1,506
Antenna and Supporting Structures	26,089	2,000	28,089	1,404
Engineering and Maintenance (non-T.C.)	—	3,039	3,039	152
Diagnostic and Treatment Equipment	74,033	—	74,033	3,702
Vehicle	<u>132,365</u>	<u>4,234</u>	<u>136,599</u>	<u>6,830</u>
Total Lockheed and NASA	954,734	53,699	1,008,433	50,422

5.4 THE NATURE OF STARPAHC UNIT COST CONSIDERATIONS

In developing unit costs under Project STARPAHC, several options are under study. These include:

5.4.1 Cost per STARPAHC Outpatient (OP) Visit

This includes the cost of treating each outpatient visit, whether or not the telecommunications system was used for each outpatient. Outpatients involved are those at the Mobile Health Unit and the Santa Rosa Clinic. Fluctuations in the number of such patients' visits have a significant impact on such unit costs from period to period. It is important to note that the cost per outpatient is related directly to an end production of the Indian Health Service. The unit is flexible, allowing for comparisons between different kinds of facilities. See Section 5.5.

5.4.2 Cost Per Hour of Operation

An alternative method of analysis which may be of limited specialized use to telecommunication planners would be cost per hour of the various systems. The difference in hours of operation between the two clinics (20 hours weekly for the Mobile Health Unit and 40 hours weekly for Santa Rosa) make it impossible to develop a common denominator. For this reason, cost per hour of operation appears under 5.6, Comparison of STARPAHC Costs Between Mobile and Fixed Site Clinics.

5.4.3 Cost Per Telecommunications Equipment Usage

This may be treated as the cost of one TV or communications usage for any piece of equipment. It may also be subdivided into data system usage, TV system usage, and communication system usage. This analysis is continuing for possible presentation at the conclusion of two years operations.

5.5 COST PER OUTPATIENT VISIT TO STARPAHC FACILITIES (See Table 5-3 and Figure 5-3)

This analysis relates the number of outpatient visits at the mobile and Santa Rosa Clinics to the total cost of operating these clinics, including the cost of telecommunications and the referral and consultative services available at Sells and Phoenix, Arizona. Such costs are presented in two alternatives; the first is based on recurring operations and maintenance costs only and the second is based on a consolidation of recurring and nonrecurring costs.

The comparisons of STARPAHC with a non-STARPAHC cost at the Sells Service Unit are presented with the caution that the baseline costs are somewhat higher than for other service units managed by the Indian Health Service because of the research and development functions conducted on this reservation.

The only telemedicine project with outpatients' costs on which data is available for comparison is the East Harlem Child Health Care Station/Mount Sinai Project. The cost per patient visit of \$52 in 1973 and \$43 in 1974 using cable TV includes communication, travel, and other costs that may not be equivalent to the cost factors encountered in the desert environment of rural Arizona.

5.5.1 Recurring Operating and Maintenance Costs per Outpatient Visit at STARPAHC Facilities

Based on 18 month operations	\$53.17
1st six months period	54.63
2nd six months period	47.54
3rd six months period	58.12

Project STARPAHC operations and maintenance includes the overall recurring costs of the government agencies involved (IHS, NASA), and Lockheed as shown in Table 5-1. The fluctuations in cost per outpatient visit from period to period reflect variations in numbers of patients served and to a lesser extent costs. The second period, covering winter months, includes more patients due generally to the volume of seasonal infections. Costs per outpatient visit were down slightly due to the increased number of patients and less demand for Lockheed Sunnyvale support. These conditions reversed during the third six-month period. A slight drop in cost per

Table 5-3

COST PER OUTPATIENT VISIT

	1st 6 Mo.	2nd 6 Mo.	3rd 6 Mo.	Total
RECURRING OPERATING AND MAINTENANCE COSTS - ALL AGENCIES				
Number of Outpatient Visits	3,931	4,659	4,131	12,721
Agency Cost				
IHS	\$112,704	\$118,922	\$123,251	\$354,877
Lockheed Site	51,988	55,536	66,435	173,959
Lockheed Sunnyvale	35,662	32,626	35,993	104,281
NASA	<u>14,400</u>	<u>14,400</u>	<u>14,400</u>	<u>43,200</u>
TOTAL COST	<u>\$214,754</u>	<u>\$221,484</u>	<u>\$240,079</u>	<u>\$676,317</u>
Recurring Cost Per Outpatient Visit	\$54.63	\$47.54	\$58.12	\$53.17
RECURRING O&M COST PLUS NONRECURRING EQUIPMENT AMORTIZATION				
Number of Outpatient Visits	3,931	4,659	4,131	12,721
O&M Cost	\$214,754	\$221,484	\$240,079	\$676,317
Amortization of Equipment and System Improvements				
IHS	2,550	2,550	2,550	7,650
Lockheed & Nasa	<u>43,127</u>	<u>49,527</u>	<u>50,422</u>	<u>143,076</u>
TOTAL COST	<u>\$260,431</u>	<u>\$273,561</u>	<u>\$293,051</u>	<u>\$827,043</u>
Recurring and Nonrecurring Cost per Outpatient Visit	<u>\$66.25</u>	<u>\$58.72</u>	<u>\$70.94</u>	<u>\$65.01</u>

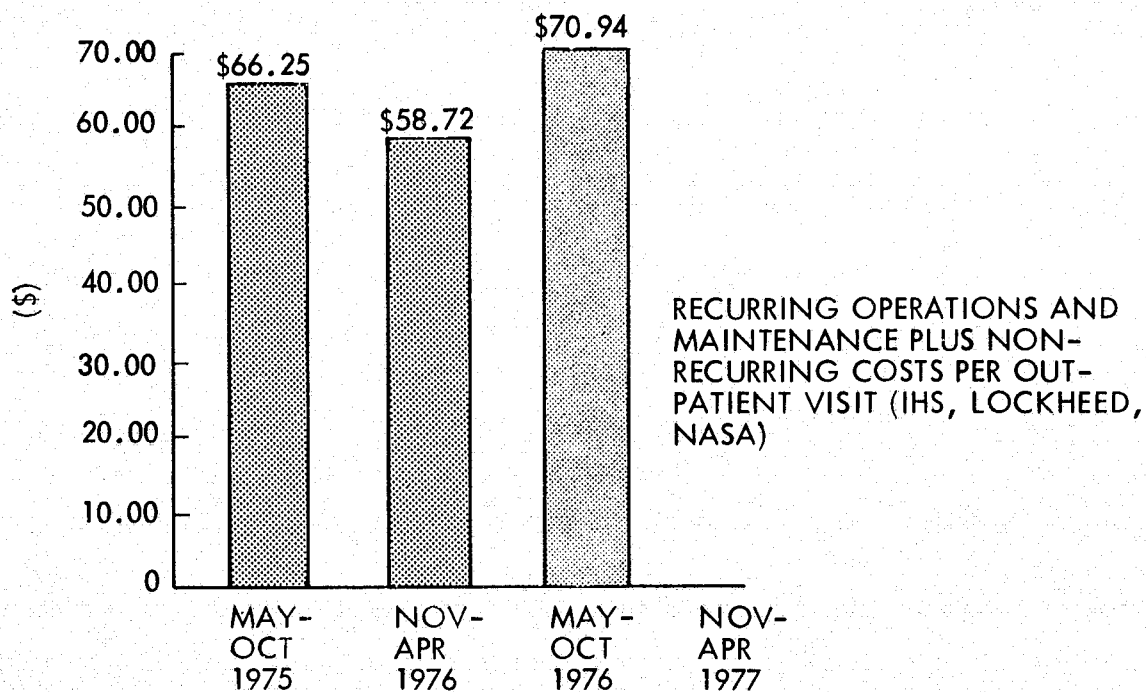
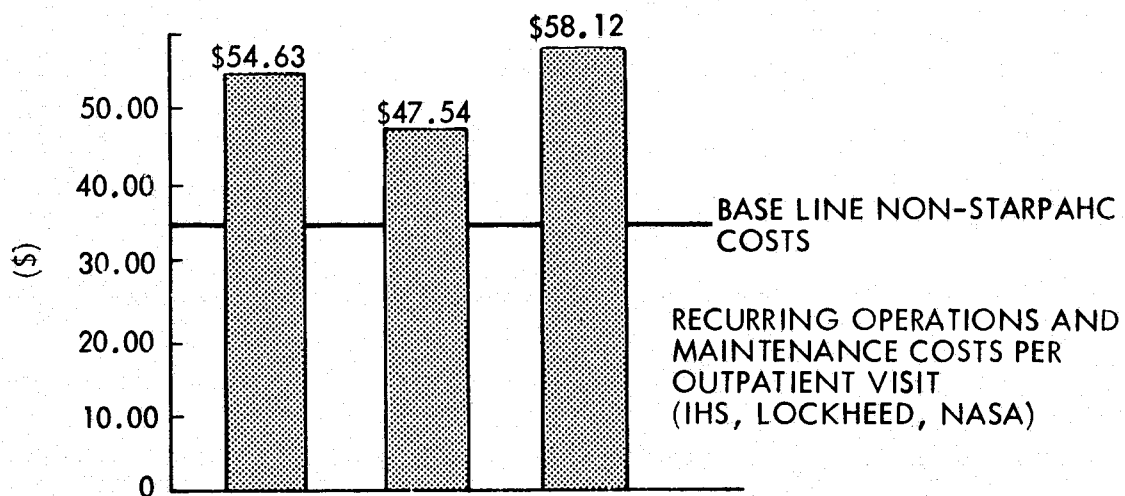


Fig. 5-3 Cost per Outpatient Visit by 6-Month Operating Period

patient is forecast for the fourth six-month period, anticipating a repetition of the previous seasonal experience.

The cumulative 18-month cost per outpatient of \$53.17 is compared with the FY 1976 cost-per-non-STARPAHC outpatient at the Sells Hospital (including patients serviced at the Santa Rosa Clinic) of \$34.00 per outpatient. The Sells Hospital Clinic employs U.S. Public Health physicians as primary providers at about \$15.00 an hour. Under STARPAHC, the health care in field clinics is provided by Community Health Medics at about \$7.50 an hour with physicians in a supervisory and referral telemedicine role.

Field conditions in the very remote areas served by STARPAHC contribute greatly to the higher cost per patient. This applies to the MHU and the fixed site clinic.

5.5.2 Cost of Consolidated Recurring and Nonrecurring Costs per Outpatient Visit at STARPAHC Facilities

Based on 18-month operations	\$65.01
1st six month period	66.25
2nd six month period	58.72
3rd six month period	70.94

This covers the summation of Project STARPAHC recurring operations and maintenance costs of all involved agencies (5.5.1) and the nonrecurring capital costs of installed equipment which, with related systems improvements, are amortized over 10 years. The fluctuations in the cost per outpatient from period to period is due to the same factors as operating and maintenance expenses (5.5.1). Amortization costs are increasing by less than \$1,000 per period, reflecting the impact of system improvements.

5.6 COMPARISON OF STARPAHC COSTS BETWEEN MOBILE AND FIXED SITE CLINICS

One aspect of the STARPAHC demonstration of interest to health care and delivery organizations is the comparative cost and usefulness of fixed site versus mobile clinics. Two STARPAHC clinics are in operation. The Mobile Health Unit spends a day each week at four villages, where it is effectively available five hours a day or twenty hours a week. The Santa Rosa Center is a long-established clinic to which the STARPAHC telemedicine features have been added. It normally operates forty hours a week as an IHS class 1.00 clinic, with a Community Health Medic (CHM) in lieu of a physician and a capacity of up to 8,860 outpatient visits annually, assuming a basic clinical team.

To make a comparison, the direct costs allocable to the MHU and Santa Rosa clinics have been identified. The remaining costs of the STARPAHC system at Sells, the Quijotoa Relay Station, and the Phoenix Referral Center are divided equally between the two facilities. Comparisons are available on (1) recurring operations and maintenance costs, (2) recurring costs plus nonrecurring costs, and (3) the design capacity versus the actual number of patients served.

5.6.1 Comparison of STARPAHC Recurring Costs Between the Mobile and Fixed Site Clinics

The analysis of recurring costs is as follows for the 18-month operating period ending October 31, 1976:

	<u>MHU</u>	<u>Santa Rosa</u>
Number of Outpatient Visits	4,777	7,944
Hours of Operation	1,550	3,100
Direct Costs of MHU and Santa Rosa	\$129,314	\$199,333
Other Recurring Costs Distributed Equally	173,835	173,835
TOTAL	<u>\$303,149</u>	<u>\$373,168</u>
Cost per Outpatient Visit	\$ 63.46	\$ 46.97
Cost per Hour of Operation	195.58	120.38

These calculations for recurring costs of operations and maintenance indicate the Mobile Health Unit to be more expensive per patient or per hour of operations than a fixed site clinic. Costs to the patient for travel and other personal expenses are excluded. The flexibility of the Mobile Health Unit may provide opportunities for service not available to a fixed site clinic. Such benefits, while difficult to measure, may be critical to decision making in any given situation.

5.6.2 Comparison of Consolidated STARPAHC Recurring & Nonrecurring Costs
Between Mobile and Fixed Site Clinics

	<u>MHU</u>	<u>Santa Rosa</u>
Recurring Costs	\$303,149	\$373,168
Nonrecurring Costs	<u>88,718</u>	<u>92,008</u>
TOTAL	<u>\$391,867</u>	<u>\$465,176</u>
Cost per Outpatient Visit	\$ 82.03	\$ 58.56
Cost per Hour of Operation	\$252.82	\$150.06

When both recurring and nonrecurring costs are considered, the cost advantage to fixed site clinic at Santa Rosa remains about the same as for recurring costs only. The MHU cost per O.P. visit exceeds Santa Rosa by 40% in this case and 35% for recurring costs. MHU cost per hour of operation exceeds Santa Rosa by 68% for both recurring and nonrecurring costs against 62% for recurring costs only.

Because the nonrecurring costs of the MHU include the amortized cost of the basic vehicle, the costs of the Santa Rosa Clinic have been expanded to give comparability by including the cost of an \$800,000 replacement clinic amortized for 40 years at \$10,000 each six month period. This compares with amortization of the MHU vehicle over a ten year period.

5.6.3 Analysis of STARPAHC Mobile and Fixed Site Clinic Capacity Compared with Actual Level of Operations

The extent to which each clinic is operating in proportion to design capacity may indicate the extent to which additional patients may be treated without a similar increase in cost.

MOBILE HEALTH UNIT

Design Capacity - Patients per Hour	2.25
Actual Patients per Hour - 18 Months, 20 Hours Weekly	3.09
Over Capacity per Hour	+0.84

The MHU design was executed in anticipation of processing 16 to 18 patients over an 8 hour day which is equivalent to approximately 2.25 patients per hour. It is now serving an average of 3.09 patients per hour but limited to a twenty hours week. This appears to be over capacity on an hourly rate but within a forty hour week potential. To increase operations to a full forty hour week, it is assumed that the number of on-site personnel would be doubled. If the number of patients processed were limited to the MHU 40 hour week design capacity, the recurring cost per outpatient would be \$51.00, a reduction of 20% under the 18 month average of \$63.46 (based on a 20 hour week). The feasibility of increased clinic hours would depend upon patient availability and uninterrupted processing.

SANTA ROSA CLINIC

Design Capacity - Patients per Hour	4.28
Actual Patients per Hour - 18 Month, 40 Hours Weekly	2.63
Under Capacity per Hour	-1.65

The Santa Rosa Clinic design capacity is rated the same as a basic IHS health center with a capacity of up to 8,860 patients annually based on agency resource allocation criteria. Since the clinic appears to be operating under capacity, it may be worth investigating the impact of full-scale operations, despite the age of the facilities and a possible shortage of floor space. To operate with a full load of patients, little or no increase in staffing appears necessary and very little change in other support costs would result. Therefore, if patient demand exists, it may be expected that recurring costs per outpatient would decrease from the \$46.97 experienced during the first 18 months of operations.

Appendix A

EVALUATION PLAN

The STARPAHC Evaluation Plan has been structured to provide data and information toward achieving these goals:

- o STARPAHC Improvement
- o Exportability *
- o Acquisition of Space System Design Data

A.1 DATA COMPILATION

Figure 3-1 illustrates the hardware evaluation approach. Acquisition of field data is accomplished through the individual site personnel daily records (system operator -- telecommunications records; computer operator -- software/hardware; maintenance technician -- daily maintenance/logistic records; site manager -- summary records and IHS daily operation records). Data from these records is entered into computer-based or manual logs. These log entries are periodically cross-checked and correlated with the IHS medical evaluation data compilations. There are four computer-based logs and two manual logs which, with their data and format, are described in Table A-1.

A.2 ANALYTICAL PROCESS

Raw data in each of the four computer-based logs is reduced to a summary printout giving pertinent data as indicated in Fig. A-1. For example, a report program for the equipment usage log produces total telecommunication transmission by facility, by type of TCE, and lists the quality and purpose of each transmission. Similarly, the Equipment Trouble Reports are summarized on a monthly basis, per specific components or in any format that lends itself to trend analyses or comparative analyses.

* Potential for use in other areas.

"Page missing from available version"

Table A-1

DATA LOGS

● Equipment Usage Log

The Usage Log identifies Date the equipment was used, Equipment Name, Purpose for the telecommunication, Quality, and Location to Location of the transmission.

● Equipment Trouble and Corrective Maintenance Report

The Trouble Report identifies Date, Hour, Equipment, Facility, Model, Location, Serial Number, When Observed, and Action Taken. Also, this report indicates parts required and a complete description of the incident. Time back on line and date is also indicated.

● Equipment Preventive Maintenance and Calibration Log

This report indicates Date, Hour, Equipment Name, Facility, Equipment Type, Manufacturer, Model, Serial Number, Location, and Description of work to be done. This report is very narrative and gives the technician a clear work schedule and exactly what manuals (if any) to use and the frequency and materials required to do any given maintenance.

● Computer System Statistics

The Computer Log provides User's Name, Tool Name, Terminal Used, Date Base Number, Number of Inputs from Terminal, and Number of Outputs to Terminal.

● Manual Cost Log

The Cost Log per se indicates only the original cost of each piece of equipment in the system by equipment types. Cost sources are varied and cover the spectrum of time charge monitoring of Lockheed site personnel to separation of cost as a result of petty cash expenditures. Only direct costs associated with the hardware will be reported.

Brief computer printouts of three computer-based logs follow.

Equipment Usage Log Computer Printout

Periodically, the data from the hand-written log is entered in the evaluation data base within the Varian mini-computer. The hard-copy log is retained as backup for the computer data. A typical example of an equipment usage log computer printout is as follows:

DATE	EQUIPMENT TYPE	PURPOSE	QUALITY	TOTA	LOCAT	LOCAT
01DEC75	VHF	COMMUNICAT	GOOD	.1	MAU	HSSCC
01DEC75	TELEMETRY (QRS)	CONTROL	GOOD	.1	HSSCC	QRS
01DEC75	HOTLINE	COMMUNICAT	GOOD	.1	MAU	HSSCC
01DEC75	COLOR TV, PATIE	CHECK OUT	GOOD	.1	MAU	HSSCC
01DEC75	COLOR TV, LAB M	CHECK OUT	GOOD	1.2	MAU	HSSCC
01DEC75	VHF	COMMUNICAT	GOOD	.1	HSSCC	QRS
01DEC75	ORDERWIRE	COMMUNICAT	GOOD	.1	QRS	HSSCC

Table A-1 (Continued)

Equipment Trouble Report Log Computer Printout

This Log is entered as soon as it is reported and remains open until fixed.
A brief extract of the computer printout is shown below:

DATE: 03DEC75	
HOUR: 0930	
EQUIPMENT NAME: MAIN GEN	
FACILITY: MAU	
FORM NAME: TROUBLE REPORT #1	
MODEL:	30EK-3R
LOCATION:	45/A01
SERIAL NO.:	
PREPARER:	P.A. RUIZ
OBSERVED DURING:	OPERATIONS
INCIDENT CLASS:	FAILURE
ACTION TAKEN:	REPLACED HIGH TENSION WIRE BETWEEN - COIL AND DISTRIBUTOR. ♦16DEC75♦
	1FT HIGH TENSION WIRES ♦16DEC75♦
PARTS REQUIRED:	.5 HRS ♦16DEC75♦
TIME FOR CORRECTION:	WIRE TO COIL OF DISTRIBUTOR BROKEN. -
DESCRIBE INCIDENT:	IMMEDIATE ACTION: TEMP. F- IX WITH TAPE.
DATE BACK ON LINE:	16DEC75 ♦16DEC75♦
TIME BACK ON LINE:	1000 ♦16DEC75♦
T.R. SERIAL NO:	302

Preventive Maintenance Instructions Log Computer Printout

The Preventive Maintenance Instructions (PMI) supports the Trouble and Corrective Maintenance report for further evaluation as to "why" and "how" the problem occurred and what future action needs to be taken to prevent a reoccurrence.

DATE: 01DEC75	
HOUR: 0003	
EQUIPMENT NAME: AUDIO/INST. RECORDER	
FACILITY: HSSCC	
FORM NAME: PM REPORT #1	
MANUFACTURER:	H.P.
MODEL:	3960F-005
SERIAL NUMBER:	2116
LOCATION:	H02/A14
MATERIALS USED:	HEAD CLEANER & COTTON SWABS
TOTAL TIME:	(.2)

The reduced raw data are next subjected to an analytical process that yields products such as arithmetical ratio, usage trends, performance acceptability ratios, transmission usage time, monthly comparisons, and frequency/distribution of equipment usage. Two of the analytical processes are concerned with (1) anomalies (any measurement/data that deviates from normal performance -- fair, poor, not acceptable quality ratings) and (2) cost. The cost analysis collects capital equipment and operational costs and then relates the data to the system and medical usage time and to the number of patients treated. This affords a measurement of the effectiveness of the system.

The products of the analytical process as shown in Figure 3-1 furnish the basis for conclusions and recommendations.

Resulting actions, as indicated in Figure 3-1, are directly associated with meeting the three evaluation goals. Specific system or design changes and cost improvements are typical of the resulting actions.

A.3 DATA AUDIT

Three methods of auditing the accuracy of the entries in the equipment usage log are (1) local surveillance, (2) surveillance during visits, and (3) review of computer printout correlated against the system manager log, the two system operator's daily written reports, and the maintenance technician daily report.

The site manager oversees and routinely checks the entries on a daily basis as part of his preparation of his daily system status report. Spot checking on accuracy of entries is done directly while observing daily occurrences.

IMSC Sunnyvale personnel, on periodic visits to the site, also directly observe entries and verify accuracy on a sampling basis. The most important surveillance is scrutiny of the daily tape printout. Because there are hourly communications with site personnel on a variety of items, status of conditions, troubles, and incidents are being discussed continually. Accuracy of the entries can be verified by cross-checking the source of information. Errors in entry have been detected and corrected by this means.

A.4 MEDICAL EVALUATION APPROACH

The purpose of this section is to provide a description of the procedures, data sources and methods utilized in the medical evaluation approach.

There are some differences between the medical usage statistics and the hardware usage statistics. This section will clarify the reasons for these differences.

The primary reason for the apparent difference lies in the different approaches taken by the evaluation studies. The medical evaluation analyzes the use of the STARPAHC equipment from the viewpoint of the impact upon patient care, whereas the hardware evaluation assesses the performance and use of equipment types.

One tool used in the medical evaluation is the analysis of each "patient episode" where telecommunication equipment is being utilized.

The hardware evaluation as discussed in previous sections, analyzes the use of each component of the telemedicine system. One parameter is the purpose of the use of each piece of communications equipment. Of the six purpose categories listed, two are related to patient services, i.e., Medical Administration and Clinical Consultation. The two patient service purposes are abbreviated as "MED/ADM" and "CHM/PHY", respectively.

The purpose for each transmission requested by the health care staff is logged by the console operator at the Sells Hospital (HSSCC). If the request is for medical records personnel to come to the physician's console room, then the purpose is always designated medical administration (MED/ADM). If the field request is for a telephone connection to another Sells office, such as the laboratory, medical records, or the pharmacy, then this purpose is also designated as MED/ADM. All requests for the Sells physicians, dentists, physical therapists etc. are entered as a clinical consultation purpose (CHM/PHY).

The Sells system operator can usually ascertain the correct purpose except when the privacy switch is in operation. The operator has been instructed not to ask the health service staff for the purpose to avoid interruption of the dialogue. If a voice connection is utilized (i.e., hot line, hands-free MUX or VHF), by the system operator or the health care staff, to discuss problems unrelated to any individual patient, then the operator has been instructed to code the purpose as "communication". If the health staff has the time to send reference signals, then this calibration activity is coded as "check out".

A.5 DATA SOURCES USED FOR MEDICAL EVALUATION

Both the hardware and medical evaluation have one common source, the systems operator's logs. The medical evaluation uses the following additional sources.

A.5.1 The Telecommunication Evaluation Forms (Tables A-2 and A-3)

These forms are to be filled out by both the sender and the receiver immediately after each teleconsultation. The information requested on each form is slightly different but similar in most respects. These forms are completed only by the health care staff, and only for transmissions relative to individual patients. Evaluation forms are filled out even when transmissions are classified as "poor" or "not acceptable". The

Table A-2

TELECONSULTATION EVALUATION FORM FOR SELLS CONSULTANTS

1) Patient ID # _____

2) Date _____

3) Provider Code of Consultant _____

4) Consultation with (Check One):
☐ 03 - Santa Rosa
☐ 77 - Ambulance
☐ 83 - MHU
☐ Px - PIMC
☐ 98 - Other

5) Reception - Indicate (✓) below, quality of transmission for each modality received during this consultation:

	Good	Fair	Poor
a. Color TV	1/	2/	3/
b. Color Endoscope	1/	2/	3/
c. Color Microscope	1/	2/	3/
d. Black & White TV	1/	2/	3/
e. Cardiostethoscope	1/	2/	3/
f. Voice	1/	2/	3/
g. Data	1/	2/	3/
h. ECG	1/	2/	3/
i. X-ray	1/	2/	3/
j. Regular Telephone	1/	2/	3/
k. Hotline	1/	2/	3/
l. Video Tape Viewed	1/	2/	3/
			Save Video Tape ☐ Yes ☐ No
m. Other _____	1/	2/	3/
n. Audio Tape Used	1/	2/	3/

6) Transmission - Indicate (✓) below, each modality you wanted to use but were unable to transmit during this consultation and reason why:

	Too Diff. Or Time Consuming	Schedule Problem	Patient Refused	Equip. Failure	Equip. Not Available	Other - Specify
a. Black & White TV	1/	2/	3/	4/	5/	6. _____
b. Voice	1/	2/	3/	4/	5/	6. _____
c. Data	1/	2/	3/	4/	5/	6. _____
d. Video Tape	1/	2/	3/	4/	5/	6. _____
e. Regular Telephone	1/	2/	3/	4/	5/	6. _____
f. Hotline	1/	2/	3/	4/	5/	6. _____
g. Slow Scan TV	1/	2/	3/	4/	5/	6. _____
h. Other _____	1/	2/	3/	4/	5/	6. _____

7) Indicate (✓) your impression of the result of this teleconsultation (Indicate responses for items a - g):

	None	Some	Great
a. Confirmed or reassured first impression	1/	2/	3/
b. Assessment of patient problems more definite	1/	2/	3/
c. Change in treatment plan	1/	2/	3/
d. Educational value to yourself	1/	2/	3/
e. Education value to remote provider or patient	1/	2/	3/

	No One	PHN	CHR	Sells	PIMC	Tucson	Other
f. Generated a referral to	1/	2/	3/	4/	5/	6/	7/
g. Eliminated a referral to:	1/	2/	3/	4/	5/	6/	7/

h. Other result or impact _____

8) In summary, this teleconsultation was (Check One):

a. ☐ Critical for the proper care of this patient

b. ☐ Important or useful

c. ☐ Of little or no value

d. ☐ Confusing or harmful

Table A-3

TELECONSULTATION EVALUATION FORM FOR SANTA ROSA CLINIC
AND MOBILE HEALTH UNIT

1) Patient ID # _____ 4) Consultation with (Check One):
☐ 01 - Sells
☐ 03 - Santa Rosa
☐ 83 - MHU
☐ Px - PIMC
☐ 98 - Other

2) Date _____

3) Provider Code _____

5) Reception - Indicate (✓) below, quality of transmission for each modality received during this consultation:

	Good	Fair	Poor
a. Black & White TV	<u>1</u>	<u>2</u>	<u>3</u>
b. Voice	<u>1</u>	<u>2</u>	<u>3</u>
c. Data	<u>1</u>	<u>2</u>	<u>3</u>
d. Video Tape Viewed	<u>1</u>	<u>2</u>	<u>3</u>
e. Regular Telephone	<u>1</u>	<u>2</u>	<u>3</u>
f. Hotline	<u>1</u>	<u>2</u>	<u>3</u>
g. Other _____	<u>1</u>	<u>2</u>	<u>3</u>
h. Audio Tape Used	<u>1</u>	<u>2</u>	<u>3</u>

6) Transmission - Indicate (✓) below, each modality you wanted to use but were unable to transmit during this consultation and reason why:

	Too Diff. or Time Consuming	Schedule Problem	Patient Refused	Equip. Failure	Equip. Not Available	Other - Specify
a. Color TV	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
b. Color Endoscope	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
c. Color Microscope	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
d. Black & White TV	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
e. Cardiotestethoscope	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
f. Voice	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
g. Data	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
h. ECG	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
i. X-ray	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
j. Regular Telephone	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
k. Hotline	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____
l. Other _____	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	6. _____

7) Reason for initiating teleconsult (Check One or More):

a. ☐ For help in diagnosing or treating patient problem
b. ☐ Patient request
c. ☐ Educational
d. ☐ By instruction or protocol
e. ☐ Other reason - specify _____

8) Indicate (✓) your impression of the result of this teleconsultation (indicate responses for items a - f):

	No One	PHN	CHR	Sells	PIMC	Tucson	Other
a. Confirmed or reassured first impression				<u>1</u>	<u>2</u>	<u>3</u>	
b. Assessment of patient problem more definite				<u>1</u>	<u>2</u>	<u>3</u>	
c. Change in treatment plan				<u>1</u>	<u>2</u>	<u>3</u>	
d. Education value to yourself				<u>1</u>	<u>2</u>	<u>3</u>	
e. Education value to patient				<u>1</u>	<u>2</u>	<u>3</u>	
f. Generated a referral to:	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
g. Eliminated a referral to:	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
h. Other result or impact							

9) In summary, this teleconsultation was (Check One):

a. ☐ Critical for the proper care of this patient
b. ☐ Important or useful
c. ☐ Of little or no value
d. ☐ Confusing or harmful

protocol has excused the health staff from completing these forms only when a voice transmission is requested via a telephone patch to a site other than the physician's console room. This exception was made at the request of the health staff to avoid the paper work. However, these transmissions are logged by the systems operator under the appropriate identification number for the patient. The other exception is when only patient data has been requested by the field staff from the STARPAHC computer at Sells.

In addition, each Sells consultant's form is stamped by a time clock at the beginning and the end of each television consultation. From this information, the time and cost by health service staff category may be calculated.

A.5.2 The Computer Printouts from the Health Information System (HIS) (Table A-4)

Each month, all patient visits to the mobile unit and to the Santa Rosa Health Clinic are received by the IHS evaluation office. The patient's name, identification number, health provider and health problems are included in this printout along with other information. This request is processed for each month at the end of the third week of the following month. This delay is for the purpose of including as many late patient encounter forms as possible and yet be able to produce a timely monthly report.

Table A-4
HIS MONTHLY PATIENT TABULATION

☐ FACILITY: MOBIL HEALTH

*****CONFIDENTIAL MEDICAL INFORMATION*****

10/21/75

PATIENT'S NAME DELETED	IID	BIRTH DATE	SEX	HR NO.	ENCTR FAC	ENCTR DATE	O F P I R S	LCDA. PROV	STAGE	DIAGNOSIS
	001495	09/10/928	M		000183	09/02/75	0 1 2 11	01/0091-1		DIARRHEA I
	001495	09/10/928	M		000183	09/02/75	0 1 1 11	01/401 -		HYPERTENSION CHECK
	001495	09/10/928	M		000183	09/02/75	0 1 2 11	01/7873-		PAIN L HIP
	002278	07/04/927	F		000183	09/02/75	0 1 2 11	01/9160-		ABRASIONS L LEG
	002278	07/04/927	F		000183	09/02/75	0 1 1 11	01/401 -		HYPERTENSION CHECK
	004042	07/16/948	F		000183	09/02/75	0 1 1 05	01/0340-		TREATED FOR POS STREP THROAT
	004124	07/09/935	F		000183	09/02/75	0 2 1 11	01/5990-		F U, U T I
	004386	11/11/966	F		000183	09/02/75	0 1 1 11	01/380 -		BILATERAL OTITIS EXTERNA
	004386	11/11/966	F		000183	09/02/75	0 1 2 11	02/9000-		SCHEDULE I V P. U T I SURVEILLANCE
	004424	03/17/950	F		000183	09/02/75	0 2 1 11	01/465 -		U R I
	004424	03/17/950	F		000183	09/02/75	0 2 2 11	01/8479-		BACK STRAIN
	004843	01/11/965	F		000183	09/02/75	0 2 1 11	01/8930-		LACERATION TOE, R FOOT
	005180	08/28/948	M		000183	09/02/75	0 1 2 11	01/Y049-		G C CONTACT
	005180	08/28/948	M		000183	09/02/75	0 1 1 11	01/401 -		HYPERTENSION CHECK
	005773	03/19/938	M		000183	09/02/75	0 1 1 11	01/7855-		ABDOMINAL DISCOMFORT UNCERTAIN ETIOLOGY
	005902	02/05/953	F		000183	09/02/75	0 1 2 11	01/0049-		SUSPECT SHIGELLA
	005902	02/05/953	F		000183	09/02/75	0 1 1 11	01/401 -		HYPERTENSION CHECK
	013068	06/22/971	F		000183	09/02/75	0 2 1 11	01/9969-		F U TRAUMA, HEMATURIA
	014309	07/31/972	M		000183	09/02/75	0 2 1 11	01/684 -		IMPETIGO SCALP, IMPROVED
	016359	12/15/973	M		000183	09/02/75	0 1 1 11	01/Y005-		IMMUNIZATIONS. WELL CHILD EXAM
	001208	07/01/936	M		000183	09/03/75	0 2 1 11	01/8100-		F U FX R CLAVICLE
	002260	02/28/927	M		000183	09/03/75	0 2 1 11	01/2959-		SCHIZOPHRENIA. THORAZINE REFILL
	003018	08/13/954	F		000183	09/03/75	0 1 2 11	01/Y009-		GRAVINDEX NEGATIVE
	003018	08/13/954	F		000183	09/03/75	0 1 1 11	01/465 -		U R I
	003361	12/25/955	F		000183	09/03/75	0 2 1 11	01/Y060-		PRENATAL
	003365	05/13/965	F		000183	09/03/75	0 1 1 11	01/7099-		LESION R 3RD FINGER
	003405	03/15/942	F		000183	09/03/75	0 2 1 11	01/Y060-		PRENATAL

*****CONFIDENTIAL MEDICAL INFORMATION*****

10/21/75

LOCKHEED MISSILES & SPACE COMPANY, INC.

A-11

A.5.3 The Patient's Health Records (Table A-5)

The complete hard copy health record for each patient whose encounter involves a STARPAHC transmission is analyzed by the evaluation office. The purpose is to describe the results of the communication within the total context of the patient's problem. The time intervals between the steps in the process of health care, and the miles traveled by the patient are documented. (The process of health care includes the time and distance between the occurrence of the problem and the first contact with the health system, the time between first contact and symptomatic treatment, first impression and definitive diagnosis, definitive diagnosis and definitive treatment, and finally, time of resolution of the problem.)

The HIS system also provides narrative medical summaries for certain patients. Patient's records are selected for critical case review if a clinical consultation utilizing the STARPAHC television equipment occurred or if the consultation results are coded as either "critical for the proper care of the patient" or "confusing or harmful" in the opinion of the health staff.

A.5.4 Interviews with the Health Staff

The STARPAHC evaluator interviews all users of the system when there is difficulty in reconstructing a patient transmission selected for critical case review. These difficulties usually arise because of incomplete records or incongruous records.

Periodically structured interviews are conducted by a trained behavioral scientist with all the health staff. This is a separate study design and report. It has not been included in this evaluation report.

TABLE A-5

HEALTH SUMMARY FROM THE HEALTH INFORMATION SYSTEM

◆◆◆◆CONFIDENTIAL PATIENT DATA◆◆◆◆

HEALTH SUMMARY

(06/04/76)

NAME: DOE-000001 , JANE PMID
 LITTLE TUCSON AZ
 SEX: FEMALE
 BIRTH: 07/01/1927
 MOTHER: MOM-LAST , MOM-FIRST MMID
 SSN: 526-47-5634
 INT ID: 6-000001
 REGISTER NDS:
 HYPER REG 00-01-HY-002869
 R.F. REG 00-01-RF-002869
 H.R. NDS:
 SELLS 00-01-01-006683
 S.X. 00-01-02-010279
 S.R. 00-01-03-001934
 PISINEMO 00-01-04-000960

REPRODUCIBILITY OF THE
 ORIGINAL PAGE IS POOR

MEASUREMENTS

DATE	WT	PCT	HT	PCT	BLD	PRS	HD	CIRC
04/03/76	137	-03			140	/100		
01/06/76					134	/080		
12/03/75	180	-00			130	/100		
10/17/75	176	-03		64	100	/080		

VISION

		UNCORR	CORR
03/21/75	SELLS	L 20/050	
		R 20/050	

◆◆◆◆CONFIDENTIAL PATIENT DATA◆◆◆◆

ACTIVE PROBLEMS

025	04/11/75	034	SELLS	ANTICOAGULATION
004	03/04/69	097	PISINEMO	DIABETES MELLITUS
016	03/11/69	024	SELLS	OBESITY EXOGENOUS
027	07/29/75	034	SELLS	PERIPHERAL NEUROPATHY

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

INACTIVE PROBLEMS

015 03/13/74 030 SELLS	ANXIETY REACTIONS
007 02/23/73 025 SELLS	OTITIS MEDIA SUPPURATIVE CHRONIC PSEUDOMONA
023 07/29/75 034 PISINEMO	R OTITIS MEDIA
022 07/29/75 034 PISINEMO	STABIS ULCER L LEG

ACTIVE MEDICATIONS

04/20/76 DISOXIN	1 TAB 250 MG	1 TIME /DAY	030
04/14/76 HYDROCHLOROTHIAZIDE	1 TAB 50 MG	1 TIME /DAY	030
04/14/76 K-LYTE	1 TAB 25MEQ K	2 TIMES/DAY	060
04/14/76 ACETONHEXAMIDE	1 TAB 500 MG	3 TIMES/DAY	090
04/03/76 BACITRACIN	9 DINT 500U/GM	1 TIME /DAY	015
04/03/76 DETERGENT, SURGICAL	3 SOLN 3 POT	1 TIME /DAY	300

◆◆◆◆CONFIDENTIAL PATIENT DATA◆◆◆◆

INPATIENT ENCOUNTERS

10/15 10/17/75 SELLS	GASTROENTERITIS, SHIGELLA ISOLATED
	DIABETES MELLITUS, MEDICATION NONCOMPLIANCE
	RHEUMATIC HEART DISEASE
10/14 10/15/75 CHS OTHER	A S H D WITH TACHYCARDIA, ATRIAL FIBRILLATION
03/07 03/12/75 SELLS	UTERINE MYOMA
	DIABETES MELLITUS
	MITRAL STENOSIS, CONGESTIVE HEART FAILURE
	MEDICATION OVERDOSE, DIGOXIN, COUMADIN, DYMELOR
04/07 04/11/75 SELLS	MITRAL STENOSIS, ATRIAL FIBRILLATION, ANTICOAG

OUTPATIENT AND FIELD ACTIVITIES

04/20/76 MD	SELLS	2 MITRAL STENOSIS 6 III F C
04/14/76 MD	SELLS	2 MED REFILL
04/03/76 CHM	SELLS	1 PUNCTURE WOUNDS L LOWER LEG
03/16/76 LPN	MAU	2 R F PROPHYLAXIS
03/10/76 DCP	HOME	2 RHEUMATIC FEVER F U
03/01/76 DCP	HOME	2 RHEUMATIC FEVER
01/20/76 MD	SELLS	2 MITRAL STENOSIS, ATRIAL FIBRIL, PUNCT II, III
01/20/76 DCP	OTHER	2 PT TRANSPORTED FOR CARDIAC CLINIC
01/16/76 DCP	HOME	2 WELL PATIENT VISIT
01/15/76 PHN	HOME	2 DIABETIC

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

SCHEDULED - ENCOUNTERS

IMMUNIZATIONS

SMALLPOX B 11/18/64
DT 3 10/07/64
SABIN TRI 3 12/02/64
INFLUENZA 2 01/02/74
INFLUENZA 12/12/73

◆◆◆◆CONFIDENTIAL PATIENT DATA◆◆◆◆

SKIN TESTS

TINE 12/29/71
PPD 04/11/75 N 00
PPD 09/07/73 N 00
PPD 05/05/70 N

LAB/X-RAY RESULTS

	04/20/76	03/12/76	01/20/76	01/06/76	12/19/75	12/03/75	10/16/75
FBS						390.	294.
POTASSIUM							4.2

SPECIAL SURVEILLANCE
HYPERTENSION

PATIENT IS HYPERTENSIVE CHECK BLOOD
PRESSURE, WEIGHT + COMPLIANCE WITH PLAN
◆05/14/76 DUE FOR MED REFILL

REGULAR SURVEILLANCE STATUS

	LAST	NEXT
◆DT	10/07/64	DUE NOW
◆COCCI		DUE NOW
CH X-RAY	04/20/76	04/20/77
◆PAP	01/22/75	DUE NOW
◆BREAST	04/11/75	DUE NOW
HEART	08/20/75	08/20/76
RECTAL	07/02/73	07/02/76

◆◆◆◆END◆◆◆◆

◆◆◆◆CONFIDENTIAL PATIENT DATA◆◆◆◆

A.5.5 Data Source Common to Both Evaluations (Table A-1)

Both studies utilize a computer printout titled "Equipment Usage Log". The program is constructed from the console operator's logs. It includes the date, type of equipment used, locations involved in the transmission, purpose of the use, and the quality of the signal as estimated by the operator.

In one respect, the printout for the hardware evaluation differs from the printout for the medical evaluation. The hardware evaluation form contains the time in minutes that each component was in use. The retrieval report used for medical evaluation contains the patient's identification number for each use of each piece of communications equipment instead of the elapsed time.

A.6 PROCEDURES FOR ANALYSIS OF UTILIZATION REPORTS

At the end of each month, the telecommunication evaluation forms from the IHS staff are received by the STARPAHC evaluator.

The computer printout from the equipment usage logs maintained by the Sells systems operator is also received. Comparisons are made, and a list of patient transmission discrepancies is generated and sent to the system operator. The operator then consults the daily hand-written logs for those transmissions reported by IHS, but not indicated in the equipment usage log printout. The missing patient consults are entered into the computer if they can be located in the daily log and matched to the patient's identification number. However, the tables prepared by the IHS evaluator for the monthly reports include all known patient transmissions whether or not they were recorded by the systems operator.

Transmissions known to the systems operators, but for which the IHS staff failed to return evaluation forms, are included in the tables reporting the ratio of use, by site and purpose, and whether voice or television was used. Charts are then located for clinical use of television (as reported by the systems operators) and analyzed for impact whether or not IHS evaluation forms are available.

Occasionally, the printout indicates that a clinical transmission occurred using certain communications equipment but the operator failed to indicate the patient's identification number. If an IHS evaluation form with an identification number is available for these transmissions, then both the hardware and medical reports will include this information, and the printout will be corrected. If no information is available to relate the transmission to an identifiable patient, then this consult will not be tallied in the IHS report. However, the hardware report will include in the totals the fact that specific items of equipment were used for clinical or administrative purposes.

The following example using a portion of the equipment usage printout should clarify the above procedure:

05May75	x	TEL-CPLR	MED/ADMIN.	GOOD	HSSCC	MHU
05May75	x	HANDSFREE, MUX	MED/ADMIN.	GOOD	MHU	HSSCC
05May75	x	HOTLINE	COMMUNICAT	GOOD	MHU	HSSCC
05May75	x	HANDSFREE, MUX	MED/ADMIN.	GOOD	MHU	HSSCC
05May75	x	HOTLINE	COMMUNICAT	GOOD	MHU	HSSCC
05May75	x	HANDSFREE, MUX	MED/ADMIN.	GOOD	MHU	HSSCC

This use of equipment occurred on May 5, between the mobile unit and the Sells hospital. In the column where the patient's number should appear, an "x" is seen instead. The purposes were indicated by the systems operator as "medical administration" and as "communication" referable to a patient.

In order to avoid losing potentially valuable data, it was agreed that the hardware tally should include these data. However, it is impossible for the IHS evaluator to decide from this data alone whether one or six patient episodes occurred. Therefore, this information is omitted from the IHS report. Every effort is made to find the missing patient numbers from the IHS evaluation reports and correct the print-out.

The totals of specific pieces of equipment used in medical transmissions in the hardware reports cannot be equal to the total of patient episodes. One patient episode could potentially account for the use of from one to twenty-two different components of STARPAHC communications equipment to complete the consultation. (The list of equipment used in the hardware evaluation does not include any computer components, nor any non-communication equipment utilization such as microscopes, X-ray machine, incubators, etc.). Few, if any, episodes used more than 8 components.

A.7 PROCEDURES FOR ANALYSIS OF PATIENT VISITS

The tally of patient visits to the mobile and fixed clinics is provided by the Health Information System printout. The information on this printout includes ID and district of residence of the patient.

The IHS evaluator requests this printout three weeks after the end of the previous month for monthly reports, and eight weeks after the end of the quarter for quarterly reports. This delay is necessary so that patient encounter forms that are delayed for being entered into the computer can be counted.

Only those "encounters" forms that relate to an actual visit to a site for health services are counted in this printout.

Each IHS evaluation form (as discussed under A.5.1) recording a STARPAHC transmission and a patient number is checked against this evidence of a patient encounter as listed in the HIS print-out. The quarterly listing of all diseases and patient problems for which the STARPAHC equipment was utilized is prepared after correlation and corrections are made.

Patient encounter forms are utilized by the health staff for many purposes other than to record an actual patient visit. Some of these purposes are to keep the computerized medical summary up to date by recording information obtained before or after the actual patient visits; to record medication renewals given to a patient attending a clinic but intended for another patient not in attendance; to schedule appointments for patients not in attendance; and many other purposes. These encounters are not totaled as patient visits in the IHS monthly evaluation reports. They are included under the category of "Other Patient Services" in the IHS quarterly reports.

On the other hand, many patients visit facilities in person and no encounter forms are generated. These visits may be for the purposes of: Bringing a specimen for a laboratory test that was requested during a formerly recorded encounter, to make an appointment for themselves or someone else, to bring letters or other documents requested by health providers, and many other reasons. On rare occasions, the provider fails to complete the encounter form, or the form fails to reach the keypunch operator in Tucson.

In addition to obtaining the number of patient visits from the HIS printout, the medical evaluation reports also include the total patient "problems" that are listed for each visit. Some "problems" as written by the health provider are actually reasons for the visit rather than health problems such as "immunizations", "well child exam".

The total of patient visits, and the total patients' problems are used to calculate two different ratios for equipment utilization in the STARPAHC project.

A.8 LIST OF MEDICAL TABLES AND CORRELATIONS TO BE COMPILED
MONTHLY IN THE EVALUATION REPORTS

1. Frequency of use by site and type of communication (voice or television).
2. Patient utilization by day for two CHM sites equipped with telecommunications (Mobile Clinic and Fixed Health Center).
3. Frequency of use of STARPAHC communications equipment by health provider category and site.
4. The reason for initiating telecommunications by site.
5. The type of impact from the completion of the telecommunication by degree.
6. The value of each telecommunication by type of health provider.
7. Frequency of failure to complete a desired telecommunication by type of equipment and reason.
8. Correlation table of patient episodes where telecommunications were used by data source (IHS or LMSC) and reason for use.
9. Summary of each patient episode where television was used for clinical consultation.
10. Summary of each patient episode valued by IHS staff as being "critical for the proper care of the patient" or "confusing or harmful".
11. Telecommunications ratio of use by number of patient visits and number of recognized patient problems.

Appendix B

STARPAHC SYSTEM DESCRIPTION

STARPAHC combines basic health care facilities, and supporting technical services into a health care delivery system. The STARPAHC operational concept is based on utilizing the professional IHS staff of the Sells Hospital, where the HSSCC is located, to provide direction and consultation to paramedical and technical personnel stationed at the remote clinics, LHSC, and the MHU. The interchange of information between the HSSCC, LHSC, and MHU is accomplished by voice, data, and video communication links. Computer-based data management techniques implements record keeping, data retrieval and data analysis.

The STARPAHC elements are operated by a team consisting of IHS-provided physicians and health-care professionals and by LMSC-provided technical personnel. Remote health-care professionals are under the direct supervision of an IHS physician at Sells by means of voice, data, and video communication channels between the STARPAHC elements interconnected by the relay station on Quijotoa (as depicted in Figure B-1). The configuration as shown in Figure B-1 consists of:

- o The control center, located in one wing of the Sells Hospital. It is staffed by IHS physicians and LMSC Telemedicine system operators.
- o A local health service center at the Santa Rosa Clinic. It is staffed by IHS CHM's and functions as a fixed remote clinic.
- o A mobile health unit. This is a clinically equipped van-type vehicle that is staffed by an IHS CHM and an IHS laboratory technician. It functions as a remote mobile clinic, visiting a number of villages on a pre-selected route and schedule.

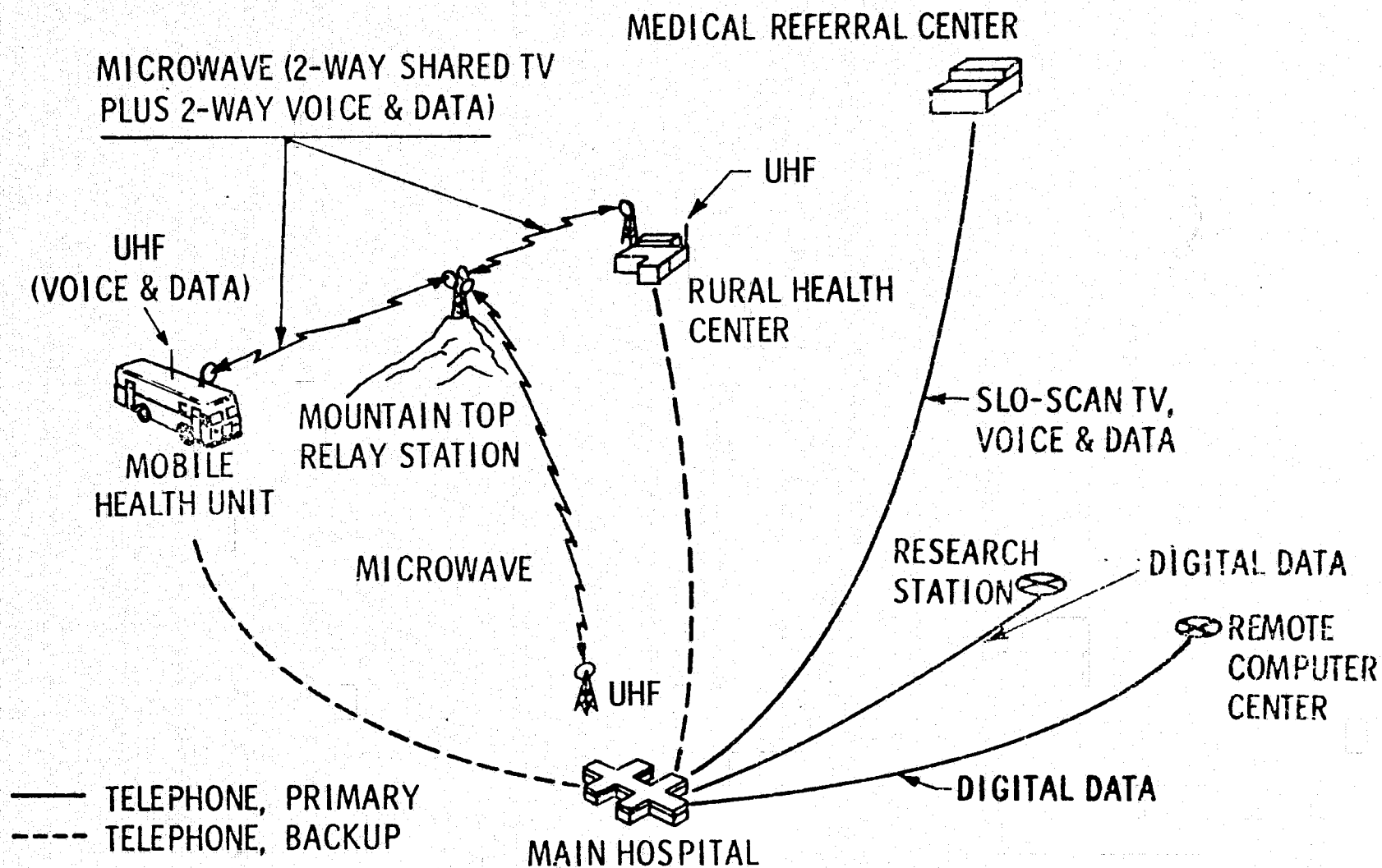


Fig. B-1 Typical Telemedicine System

- o The Phoenix Referral Center. This facility provides a Telemedicine room in the Indian Health Service Hospital in Phoenix for access to specialists (through audio and slo-scan television links) from the control center.
- o The Albuquerque Computer Center. This facility provides STARPAHC data system access to the Indian Health Service patient information system data base.
- o The Quijotoa Relay Station. This station is used for microwave transmission of television, voice, and data and VHF voice/data between major system elements.

B.1 HSSCC

The Indian Hospital at Sells, Arizona contains the Control Center of the system. Here, the physician directs the community health medics and laboratory technicians, communicates with patients, and calls up data to assist in the examination and treatment of patients.

The physician also can consult with specialists at the Phoenix Indian Health Hospital and can direct the system operator to perform specific functions such as recording a TV image, sending slo-scan TV X-ray images to Phoenix, and selecting other needed communications modes.

The nerve center of the STARPAHC communications system is contained in the Operator/Communication room at Sells. From the operator's console, the system operator interconnects all video, voice, and data links in the system by means of the equipment in the room. Communication outputs and inputs are provided in three separate modes: microwave (video, voice, data); VHF radio (voice, data); and telephone (voice, data, single-phased recorded video).

The data equipment room at Sells contains the computer system and data bank and peripheral data equipment. STARPAHC data is fed into the computer from LHSC, MHU, and other remote location video display, teletypewriter, and printer sources. This information is stored in the data base for playback to all sources or to the Tucson Computer Center (TCC). Information at the TCC can also be received and routed to STARPAHC locations by the Sells computer.

The Physician's Room at Sells contains equipment and apparatus allowing the physician to view, hear, and direct medical activities at the MHU and the LHSC, to communicate visually or by voice with all other elements of the STARPAHC system; to ask for and receive computerized patient's records and other data; and to have consultation with other physicians at the PRC. The Physician carries out these activities with a minimum of controls from his desk at the Physician's Console. In addition to the Console, he has at his disposal a 3-channel ECG cart with cardioscope/strip-chart recorder, and a B&W TV camera and X-ray film viewer. A dedicated B&W TV camera is housed in his console to provide his image to the patient at the MHU and LHSC. All of this equipment can be operated by the physician while seated at the console.

The HSSCC provides space for a VHF radio controller to enable communications with the existing IHS ambulance radio frequency. An area and interface capability is also provided at the HSSCC for a base station for communication with a Portable Ambulance Module (PAM) installed in the IHS Ambulance Van.

Interface between the HSSCC and the Tucson Computer Center is by high-speed serial-digital signals via telephone lines.

B.2 LHSC

The Santa Rosa Clinic is an existing clinic whose capabilities are enhanced by the telecommunication equipment provided by the STARPAHC system. The clinic is well equipped and staffed by paramedical personnel, laboratory technicians, and a secretary/receptionist. It provides the physician at the hospital control center with an "outreach" capability to deliver quality health care to patients through the STARPAHC system. There are three rooms in the clinic used for STARPAHC applications.

The Emergency Room at the Santa Rosa Clinic contains the STARPAHC operational console which is the central controlling unit for all of the clinic's STARPAHC equipment. The console controls the transmission and reception of visual and audio signals to and from Sells Hospital from several rooms including the Emergency Room. It also contains the individual controls that operate the two TV cameras and the intercom. One camera is used for patient viewing while the other is used for endoscopic examinations. A video data terminal is located in the room to receive, send, and display information to and from the HSSCC computer.

The Examination Room, like the Emergency Room, has an intercom system and a video data terminal (identical to the emergency room's unit), a B&W camera and monitor is located in the room that can be used for sending X-ray images or any other visual data and can also be used for patient monitoring.

The Laboratory at the Santa Rosa Clinic has intercom units, a color TV camera matched to a standard binocular microscope, and a color monitor for viewing the transmitted slide image.

The Data Management area is a small room outside of the main entrance to the clinic. The room contains the two equipment rack assemblies that power and control all of the television, voice, and data communications equipment. The room is air conditioned to provide cool operating temperatures for the equipment, and comfort for maintenance personnel. A room-to-room intercom is provided.

A 55-KW Auxiliary Generator is permanently mounted on a concrete foundation outside the rear of the LHSC. This generator provides electric power to the clinic and all electric equipment in the event of a failure of the regular power supply.

B.3 MOBILE HEALTH UNIT (MHU)

The MHU is a smaller version of the Santa Rosa Clinic. It serves rural populations by scheduled visits to four Papago Villages Monday through Thursday. Friday and Saturday are used for clean-up, maintenance, and repair. Overall vehicle specifications are:

Overhead Clearance	16 ft
Vehicle Width	8 ft
Vehicle Length	35.6 ft
Vehicle Length with Trailer	51 ft
Maximum Permissible Speed	45 mph
Fuel Capacity	60 gal

The MHU has four areas: 1) Cab, 2) Examination Room, 3) Reception/Communication/Lab Room, and 4) X-Ray Room. A 30-KW generator is mounted on a trailer which is towed behind the MHU.

The MHU has a number of two-way communication devices, both audio and visual, to permit full coverage of all situations between the MHU and Sells Hospital. The MHU roof antenna allows microwave TV and voice transmission from and to HSSCC via the Quijotoa Relay Station. VHF capability between LHSC and HSSCC is also available. Teletype and data equipment, both visual and printout, are provided for data input and retrieval, and the equipment is connected into computers serving the system. Inside the van, a

room-to-room intercom is provided. When the van is unattended, an outside VHF handset can be used for emergency calls to Sells, and an alarm system will automatically sound an alert at Sells in case of fire, break-in, or an emergency call.

Most of the communications equipment in the MHU is controlled by or through the control panels located in each of these rooms. A hotline RF telephone is wall-mounted in both the Examination and the Reception Rooms which allows private talks with the HSSCC physician or operator.

Color TV monitors are provided in the Examination Room and the Laboratory area for monitoring transmitted images or for monitoring the transmitted Sells physician image. A B&W monitor is used in the X-ray room to view the transmitted X-ray images. Color TV cameras are used to send color pictures of the patient to the physician's console at Sells. One camera is used for standard patient viewing while the other is used for endoscopic examinations. A color TV camera combined with a microscope is located in the laboratory area for transmission of microscopic slide images.

A teleprinter is used in the reception area for sending or retrieving printed patient's records and other information. A CRT data terminal is located in the examination room which performs a similar function.

B.3.1 Staffing

The arrival times and service times of patients who used the Mobile Health Unit (MHU) of the Sells Service Unit were observed during the weeks of March 22-25 and July 19-22, 1976. The clinic provides out-patient care to patients from 10:00 AM to 3:00 PM, four days a week in four villages in the western part of the Papago Reservation.

During both observation periods, the unit was staffed by the same Community Health Medic (CHM), who also functions as the pharmacist and the X-ray and laboratory technician. The Licensed Practical Nurse, in March, was replaced by a Community Health Nurse's Aide for July. There was a different driver during each observation period. Some of the clinic hours, the driver spends transporting patients, the rest of the time he assists by obtaining the medical summaries and performing clinical duties. The driver and/or the nurse also provide interpreter skills for the CHM.

B.3.2 Travel Pattern

The Mobile Health Unit followed the same travel pattern during both observation periods; it was driven from Sells to Pisinimo on Monday morning and left there overnight; moved from Pisinimo to Gu Vo on Tuesday morning; and brought into Quijotoa Tuesday afternoon to be refueled and left for the night; picked up at Quijotoa Wednesday morning and driven to Hickiwan; on to Kala Wednesday afternoon in preparation for the next day's clinic; and returned to Sells after close of clinic on Thursday. The unit remains in Sells on Friday for maintenance, cleaning, and restocking. Please refer to Figure B-1.

A carryall and a sedan are used as support vehicles, the carryall to transport patients to and from the MHU and nearby villages, and also to transport the staff from Sells to the clinic location during the week. The sedan is used by the driver to reach the MHU from his home in Santa Rosa. The average driving time for the staff to the clinic site each day is one hour and 15 minutes. The return trip time is longer on Tuesday and Wednesday because the unit is moved to its overnight location after the clinic closes, and one of the support vehicles must follow it to provide transportation home for the driver. One round trip each week for the Mobile Unit is 291 miles.

B.3.3 Patient Transportation

On Monday, the carryall is taken to Santa Cruz and Nestors by the driver to pick up and deliver patients to Pisinimo. On Thursday, the CHM picks up patients in Ventana and takes them to Kaka. After being taken, they are returned by the driver to Ventana. Community Health Representatives also provide transportation to the MHU for some patients from the above communities plus Ali Chuk, Pia Oik, Sioui Schuatak, Kuakatch (to Gu Vo), Schuchuli, Hotason Vo, Vaya Chin (to Hickiwan), Stan Shuatak, Chuwat Murk (to Pisinimo). (Figure II-1). Altogether, 16 communities with a total population of about 1755 are served by this clinic.

B.3.4 Unit Preparation

It takes the driver an average of 20 minutes to set up the unit each morning, lowering the stabilizing jacks at the rear of the unit and placing hand jacks under the front end for stabilization during operation, connecting the unit to the generator it tows in a small trailer for its power source, and putting up and adjusting the dish antenna which provides the microwave communication link between the MHU and Sells. Two men from each village have assumed the responsibility for setting up the portable stairs, which are heavy and awkward for one person to handle. Stairs are set up to the center room of the unit only, although two sets of stairs are carried on the trailer. After close of clinic, it takes an average of 25 minutes to secure the unit for the night, or to get it ready to travel.

B.3.5 Clinic Preparation

While the unit is being set up, the nurse and the medic prepare for the start of clinic, putting away any supplies which were brought from Sells, checking and arranging equipment and

reviewing laboratory reports about patients from that day's clinic area. Although the clinic is not scheduled to begin until 10:00 AM, patients sign in as they arrive, sometimes as early as 9:40 AM. As soon as the patient signs in, an encounter form is stamped and a medical summary retrieved from the Varian computer at Sells through the teletypewriter.

B.3.6 Clinic Operation

About 10:00 AM, the nurse starts to call and screen the patients. If the patient is also to receive service from the medic, he usually returns to the waiting area outside the MHU after screening until called by the CHM.

The staff makes an effort to complete service for the patients who arrived during the morning before stopping for a half-hour lunch, usually about 12:15 PM. The majority of patients are seen in the morning. During the observation period, the time by which all patients had completed services varied between 2:12 PM (March 25th) and 3:22 PM (March 22nd).

Mean waiting and service times for each service point in the MHU are shown in Table B-1 for the March observation period, and in Table B-2 for the July observation period. The total average time from sign-in to completion of services is similar for both periods: 54.8 minutes for March, 55.7 minutes for July. The average total service time to waiting time ratios are also similar: 14.0; 40.8 (March) and 14.9; 40.8 (July) -- expressed in minutes. The bulk of the waiting times occurred between sign-in and being called by the nurse. This is not surprising because many of the patients arrived in groups of three to nine -- about one-fourth during the March observation period and over half in July.

TABLE B-1

Mean Waiting and Service Times* Per Patient, Each Day and All Days
 Mobile Health Unit, Sells Service Unit, March 22-25, 1976
 N=94 Patients: Total

Periods	Monday Pisinimo	Tuesday Gu Vo	Wednesday Hickiwan	Thursday KaKa	Mean All Days	Number of Persons Going Through This Point
Time elapsed from signing in until called by nurse	35.7	38.3	37.0	11.0	33.6	87
Nursing service time	7.2	4.0	5.6	3.7	5.1	87
Waiting time to see CHM	9.6	7.8	4.4	5.0	7.2	88
CHM service time	11.1	6.9	10.1	9.3	8.9	90
Number of patients observed	24	38	19	13	27	--

*Times are in minutes. All patients did not go through each station.

Table B-2

Mean Waiting and Service Times * Per Patient Each Day and All Days
 Mobile Health Unit, Sells Service Unit, July 19-22, 1976
 N = 78 Patients : Total

Periods	Monday Pisinemo	Tuesday GuVo	Wednesday Hickiwan	Thursday Kaka	Mean All Days	Number of Persons Going Through This Point
Time elapsed from signing-in until called by nurse	26.9	44.5	25.5	19.7	29.2	74
Nursing Service Time	6.2	4.6	5.4	4.3	5.1	71
Waiting Time To See C.H.M.	18.3	5.0	14.3	8.9	11.6	77
C.H.M. Service Time	10.1	10.4	10.2	8.3	9.8	77
Number of Patients Observed	21	24	18	15	19.5	--

B-12

* Times are in minutes. All patients did not go through each station, for instance four patients went directly from sign-in to service by the C.H.M.

The particularly long (44.5 minutes) sign-in until called by nurse time for July 20th was the result of the arrival of an emergency patient at 10:07 AM. This patient was a boy who had fallen from his horse that morning and was brought to the MHU by private automobile. The CHM first examined him in the car, then moved him into the MHU for X-rays. The X-ray machine was not working so the CHM applied a sling to the injured arm and arranged to have the patient transported to Santa Rosa Health Center for X-rays. The first scheduled clinic patient was not called until the emergency service was completed at 10:42 AM.

B.3.7 Equipment Malfunctioning

There were several equipment problems that altered usual functioning of the unit during the observation periods.

The computer was not working for 10 clinic hours during the March time frame and for 5-3/4 hours during the July 19-22 period. This meant that more radio calls than usual had to be made to Sells at these times to retrieve patient information such as immunization status, etc. During the July observation period, the toilet had been pulled from the unit for repair, which meant there was no place for the patient to collect a urine specimen, so no urine clinitests or urinalysis were done during that week. The X-ray machine was not working July 19-22, so three patients were referred to Santa Rosa Health Center or Sells for X-rays. The paging system was not functioning reliably some of the week, which may have contributed to the number of "no answers" (seven on Monday), although the nurse felt that in most instances, the patients had left the waiting area to go to the store nearby. There were two patients who were signed in, but never did answer a call. One was a child signed in by his mother, who then left to go home and get him and did not return. The other, according to the staff, frequently signs in but does not stay to get service.

B.3.8 Laboratory Use

There was only one laboratory test performed on the MHU during the July study period -- a hematocrit. Seventeen laboratory specimens were brought into Sells laboratory for testing: eleven cultures (six of them skin cultures) and six blood chemistries. The nurse on the unit in July was not trained to do vena punctures, so the CHM drew all the blood for testing. The nurse took most of the cultures.

B.3.9 STARPAHC Communications

Communications from the MHU during the observational periods are shown in Table B-3 (March) and Table B-4 (July). The effect of the data system failure is seen for days #2 and #3 in the first and day #1 in the latter. Had the X-ray machine been operable during the July period, two of the three patients referred would probably have had their film images sent to Sells via television for a physician consult.

B.3.10 Patient Population

On August 3, 1976, the Health Information System had reported in 170 of the 172 total patient visits which occurred on the MHU during the two observation periods. In describing that population by age, sex, and primary diagnosis, it shows a predominately young (62% 14 years of age), female (59%) group with the most common primary diagnosis of upper respiratory infection. The age distribution during both study periods is very similar. (Figure B-2) The sex distribution was more predominately female during the March period.

	Male		Female	
	Number	Percent	Number	Percent
March 22 - 25	36	37%	58	63%
July 19 - 22	31	44%	39	56%
Both Periods	67	41%	97	59%

Table B-3

Telecommunications About Patients
From the Mobile Clinic by Type and Purpose
During the Observation Period

March 22, - 25, 1976

Purpose: M=Medical-Administration

C=Clinical Consultation

Type of Telecommunication Purpose	NUMBER OF PATIENTS						Totals	
	Voice Alone		Voice plus Return TV		Voice + 2-Way TV		# Consults	% Of Visits
	M	C	M	C	M	C		
Date Site (# of Visits)								
1. Pisinimo (24)	3	1	1	0	0	0	5	20.8
(1)								
2. Gu Vo (38)	2	0	6	0	1	0	9	23.7
(1)								
3. Hickiwan (19)	4	1	0	0	0	0	5	26.3
(1)								
4. Kaka (15)	0	0	0	0	0	2 ⁽²⁾	2	15.4
(1)								
Totals (94)	9	2	7	0	1	2	21	22.3

(1) Computer providing medical data not functioning for days 2 and 3.

(2) Includes transmission of a chest x-ray. Patient subsequently sent to Sells Hospital.

TABLE B-4.2

Telecommunication About Patients
From the Mobile Clinic by Type
During the Observation Period July 19-22, 1976

Purpose: Calls to Medical Records, Laboratory, Disease Control
and Santa Rosa Health Center

Type of Communication (1)	Number of Patients		Totals	
	Voice Alone	Voice Plus Return T. V.	# Consults	% of Visits
<u>Day</u> <u>Site</u> (# of visits)				
(2) 1. Pisinemo (21)	3	2	5	23.8
2. GuVo (24)	1	0	1	4.2
3. Hickiwan (18)	1	0	1	5.6
4. Kaka (15)	1	0	1	6.7
Totals (78)	6	2	8	10.2

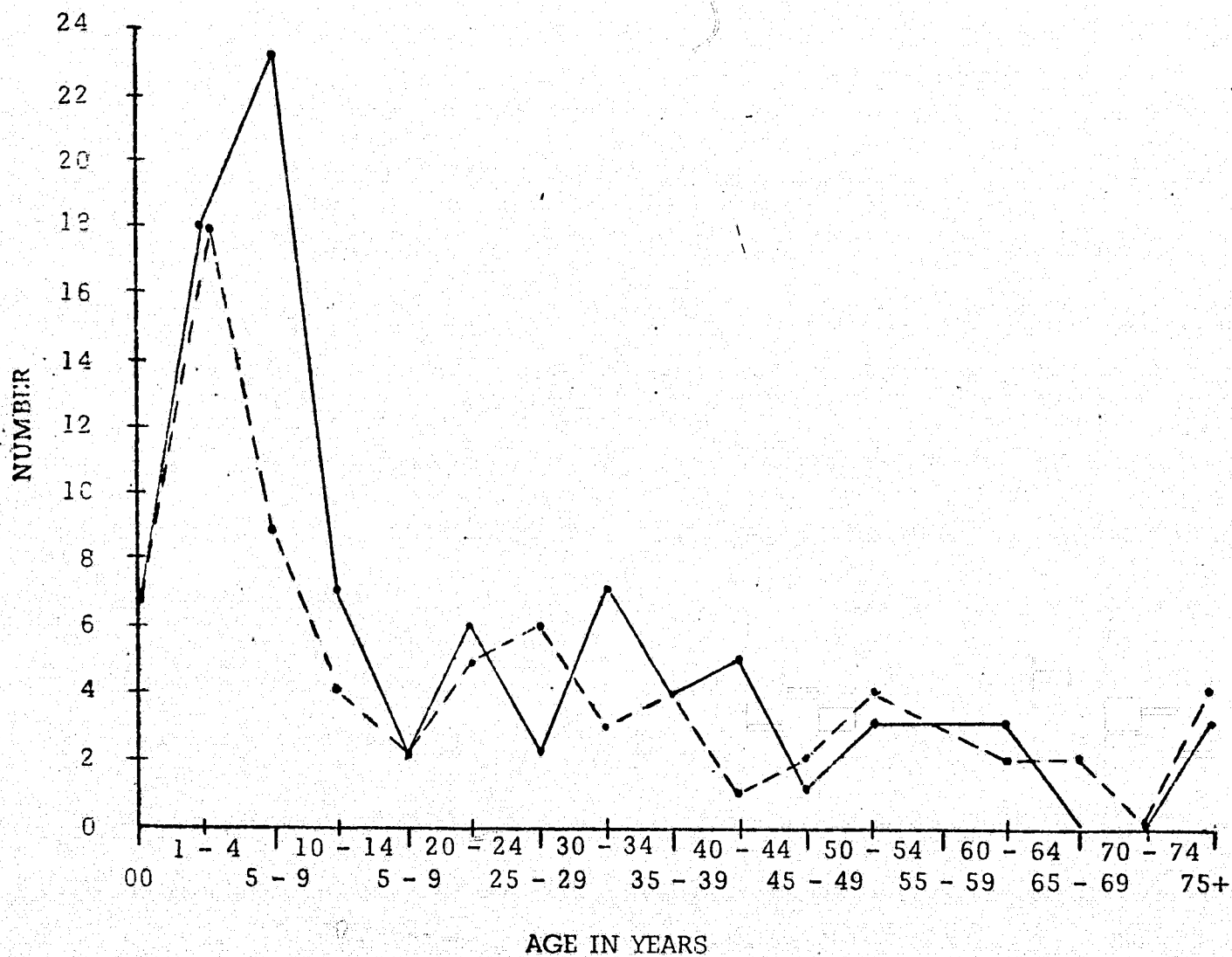
(1) No use was made of microwave equipment from the mobile unit for consultation with a physician during this week.

(2) Computer providing medical data not functioning most of day #1.

FIGURE B-2

Age Distribution of Patients Visiting the Mobile Health Unit During the Observation Periods: March 22-25, and July 19-22, 1976.*

N = 172: Total



— March 22-25, 1976

- - - July 19-22, 1976

* Data from the Health Information System retrieved August 3, 1976.

The March study period also had a higher percentage of infectious diseases as a primary diagnosis: 52.5% compared with 35.7% for July. Patient visits by primary diagnosis are displayed in Table B-5.

B.3.11 Staff Interview

The CHM who was staffing the MHU during these observation periods has worked on the unit for a year and worked at the Santa Rosa Health Center for the previous year (also a single provider, CHM, outpatient clinic). On interview, he had several interesting comments on service and waiting time comparisons between the two facilities. Although he felt waiting times at the two clinics were probably objectively comparable -- both clinics have patients arriving in groups -- that subjectively, the MHU patients would feel they waited longer because they have to wait outside with only a ramada for protection from the weather, whereas the Santa Rosa patients wait in a building that is heated in the winter, cooled in the summer, and have a television to help pass the time.

He felt that service times on the MHU would be shorter for two reasons: (1) the MHU is more compact and the provider can do the examination, treatment, and dispensing all in one location, but in Santa Rosa, he may have to move himself and the patient to several different locations in the clinic to complete services, which may lengthen service time for comparable service rendered; (2) although both clinics run a similar patient census, the MHU's clinic is operating for four and a half hours and Santa Rosa is usually operating six to eight hours, which puts pressure on the MHU provider to limit service time.

TABLE B-5

Patient Visits by Primary Diagnosis to the Mobile Health Unit:
 March 22-25, July 19-22, 1976
 N = 172 : Total

Primary Diagnosis	March 22-25		July 19-22		Totals	
	#	%	#	%	#	%
Upper Respiratory Infection	21	22.3	8	11.4	29	16.9
Laboratory Exam Only	1	1.1	11	14.1	12	7.0
Otitis Media	8	8.5	2	9.0	10	5.8
Diabetes Mellitus	3	3.1	6	8.5	9	5.2
Follow-up Exam, Disease or Operation	9	9.6	0	0.0	9	5.2
Essential Benigh Hypertension	3	3.1	5	7.0	8	4.7
Well Child Exam	2	2.1	4	5.1	6	3.5
Impetigo	1	1.1	5	7.0	6	3.0
Immunization or Vaccination	3	3.2	2	2.6	5	2.9
Pneumonia	3	3.1	0	0.0	3	1.7
Mumps	3	3.1	0	0.0	3	1.7
Subtotal	57	60.6	43	55.1	100	58.1
All Other Primary Diagnosis	37	39.4	33	42.3	70	40.7
Late Reporting	0	0.0	2	2.6	2	1.2
Totals	94	54.7	78	75.3	172	100.0

* Data from the Health Information System retrieved August 3, 1976.

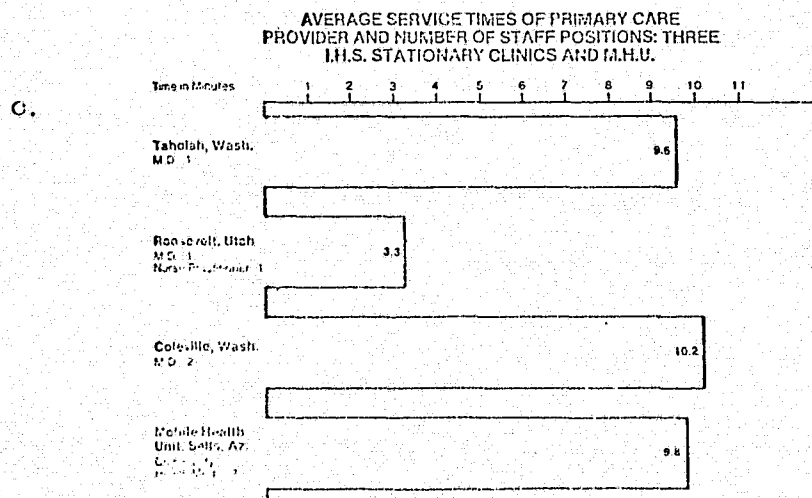
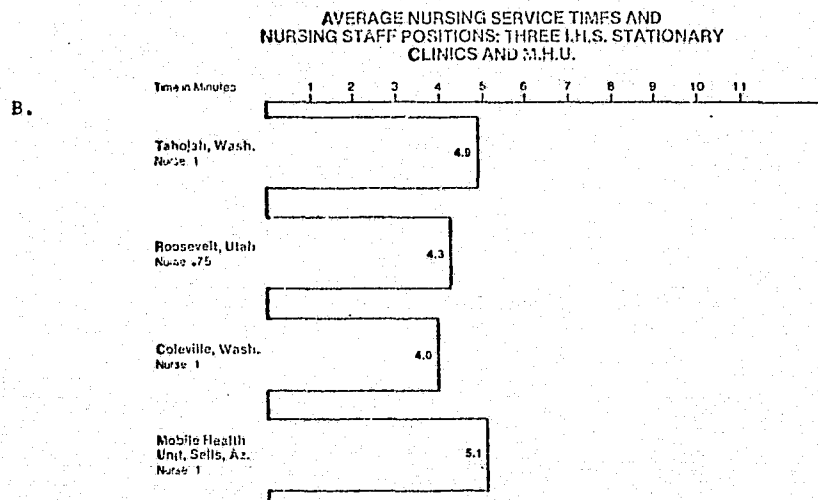
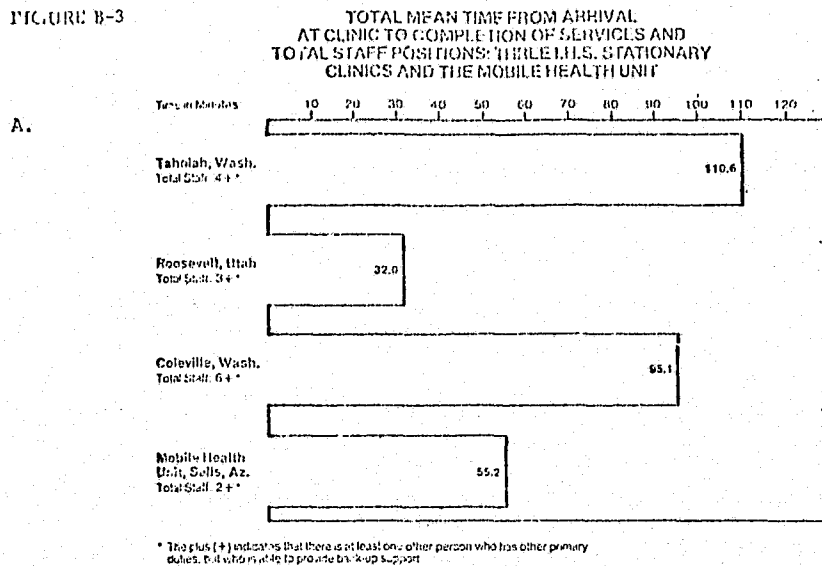
In discussing the value of having the black and white television monitoring of the consultant at Sells during teleconsults, he stated he had no comments from the patients. He had observed that when the TV monitor was on, the patient would interact directly with the Sells consultant, but when only the hands-free MUX was used, the patient would wait for the CHM to repeat questions and instructions before responding, even though the patient could hear and understand the Sells consultant. He said he has also used the two-way video capability to set up private consultations between a patient and a Papago Psychological Service staff member, which he doesn't feel would be feasible if only voice reception for the patient were possible.

B.3.12 Discussion

The uniqueness of the Mobile Health Unit makes it difficult to compare it to a fixed clinic facility. Patient clinic times and service times at three IHS stationary facilities that operate primarily as a single provider clinics are displayed in Figure B-3 with similar data on the Mobile Health Unit. The data on the three stationary clinics are taken from "A Summary of the Outpatient Studies Project - April 1976", Office of Technical Assistance, DHEW, PHS, IHS, ORD, HPSC, Tucson, Arizona. It is noted there is more variability of the selected parameters among the stationary clinics than between the stationary clinics and the MHU.

At the Taholah, Washington clinic, the provider is a physician, the nurse is an R.N., the pharmacist also provides X-ray and laboratory technician skills, and there is one person to handle medical records and do some clerical work. At the Roosevelt, Utah clinic the providers are a physician and a Nurse Practitioner who acts as primary provider sometimes and does laboratory work and dispenses pharmaceuticals. This clinic is attached to a community hospital and clinic patient X-rays are done in the

FIGURE B-3



hospital X-ray department. They also have a clerk to handle medical records. At the Coleville, Washington clinic, the provider is a physician. There are two on the staff, but for two days each week, one physician operates the clinic and the other holds clinics in the field. The nurse is an R.N., there is a pharmacist who also provides X-ray skills, a laboratory technician and a clerk. All three of the stationary clinics have at least one clerical person who may have other primary duties, but who is able to provide back-up support.

Additional variations that make comparisons difficult are related to the work load at each site the percent measured, and the duration of observation. These variables are listed in Table B-6.

Table B-6
Patient Visits, Total and Observed
4 Sites, Indian Health Service

Sites	No. Patient Visits Annual	No. Patient Visits Observed	% Of Annual Number	Observation Period Days
Taholah Health Ctr.	8,019	838	10.5	22
Roosevelt Health Ctr.	13,300	1,001	7.5	18
Colville Health Ctr.	10,366	764	7.4	19
Mobile Clinic, Sells	3,377	172	5.1	8

B.4 QRS

The QRS is located on the Quijotoa range which is approximately 3800 feet high. A good access road is available that is easily negotiated by a 4-wheel vehicle. The QRS provides a central location covering 350 degrees of coverage over the Papago Indian Reservation. There are three dual-feed dish antennas mounted on a 30-ft tower. They are dedicated to the HSSCC, LHSC, and MHU. The MHU antenna positioner can be rotated through 350 degrees covering all village stops presently scheduled and is capable of extending village coverage if needed. There is an 8' x 8' air conditioned shelter housing the communication equipment, battery charger, and batteries. A 2.5-KW wind generator provides primary power and a 6-KW diesel generator provides backup power.

B.5 PRC

The Indian Health Hospital at Phoenix, Arizona, which is referred to as the Phoenix Referral Center, is staffed with and has access to medical specialists. In the STARPAHC system, these specialists will be called upon to consult with the physicians at the HSSCC when unique or complex medical advice is in order. To enhance the consultation, the system provides the capability for transmitting X-rays or pictures of the patient, lesions, etc., via slow-scan TV using existing telephone lines. These same telephone lines also provide capability for voice communication and data transmission between the HSSCC and the PRC. The slow-scan capability provides X-rays or picture transmission in two minutes. It inherently records the transmission which enables almost unlimited playback capability for extensive, repetitive studying at different times and for various durations.

Appendix C

TROUBLE REPORT REVIEW

A detailed review of Trouble Reports for each of the months of the third 6-months was completed and forms this appendix.

May Trouble Reports. Nature of the 25 May TR's were:

Failures (10), Degradation (14), and Modification (1).

The ten failures were divided among the elements as follows:

MHU (3), LHSC (4), HSSCC (2), and the QRS (1). The MHU failures required repair work, while the majority of the LHSC failures required replacement of parts. One of the HSSCC failures was attributed to operator error. The division between repair/replacement was 5/5.

The principal equipment types experiencing failure were: control receiver for cameras (3), RF voice link, generator, and terminal (2 ea.). One failure is attributed to operator error.

Three of the May equipment failures out of ten resulted in operational down-time. The MHU Camera Control had a partial failure resulting in 18 hours of down-time. The unit could not be repaired in the field and had to wait until the MHU returned to Sells on Friday. The MHU Auxiliary Generator failed one evening in the field and remained inoperative overnight. The generator was repaired the following morning. A total down-time was recorded of 12 hours. The third failure was a HSSCC GE terminal which resulted in 1½ hours of down-time. It was repaired during operational hours.

The 14 degradations were divided among the elements as follows: MHU (4), LHSC (1), HSSCC (6), and the QRS (3). The MHU degradations were corrected by repair/replacement of parts, the LHSC degradations required replacement of parts, the majority of the HSSCC degradations required repair, while the QRS degradations required both repair/replacement. The division between repair/replacement was 7/7.

The principal equipment types experiencing degradation were: generator (3), terminal (3), video (2), voice (1), vehicle engine (2), QRS (1), and the wind driven generator tower (2).

In summary, during May, a total of 25 Trouble Reports were opened: 22 were closed. The 25 TRs were distributed among the elements as follows: MHU (7), LHSC (5), HSSCC (9), and QRS (4).

The principal equipment types having troubles were: computer terminals (6), generators (5), camera/control (5), voice (3), QRS wind driven generator tower (2), and MHU vehicle, video, misc., (1) each. There was one trouble report attributed to operator error.

Total down-time recorded during May was 31 $\frac{1}{2}$ hours. Comparison of May data against prior year of operation shows that May's TR's are slightly above the yearly average (25 compared to 21.9 TR's). A comparison of the one year operation regarding equipment types shows that the computer/terminals remain as a high source of trouble reports. This is associated with four computer and two terminal problems. Next highest trouble reports in May concerned generators which are also the second highest average yearly source of troubles. Two TR's were for the 30 KW MHU generator (2 weeks apart, and not associated), two TR's were for the MHU 6.5 KW aux generator (3 weeks apart and associated), and 1 TR on the QRS diesel 6.5 KW generator. Three of the TR's reported had start or fail to start which were repaired by tune-ups. The other two TR's were associated with mechanical problems.

June Trouble Reports. Nature of the 27 June TR's were: Failures (15), Degradation (10), Deficiency (1), and Modification (1).

The 15 Failures were divided among the elements as follows: MHU (6), HSSCC (5), and QRS (4). The majority of the MHU and the LHSC failures required repair, while the majority of the HSSCC required replacement. The QRS failures were fixed equally between repair/replacement. The division between repair/replacement was 9/6.

The principal equipment types experiencing failures were: computer terminals (5), generators (4), camera/control (2), and MHU equipment and wind-driven generator (1 each). Two failures were attributed to operator error.

Two of the June equipment failures out of fifteen required in operational down-time. The HSSCC computer was down for three hours due to a blown fuse caused by low input power. The MHU main generator was down for two hours.

The ten degradations were divided among the elements as follows: MHU (3), LHSC (2), HSSCC (4), and QRS (1). The MHU and LHSC degradations were fixed by repair. The HSSCC degradations required both repair/replacement while the QRS required only replacement. The division between repair/replacement was 6/4.

The principal equipment types experiencing degradation were: computer/terminals (4), camera/control (3 ea.), and the MHU vehicle (2) and voice (1).

In summary, during June, a total of 27 trouble reports were opened and 25 were closed. The 27 TR's were distributed among the elements as follows: MHU (10), LHSC (3), HSSCC (9), and QRS (5). The principal equipment types having troubles were: computer/terminals (9), camera/controls (5), generators (4), MHU vehicle (3), and MHU equipment, voice, miscellaneous, and wind-driven generator (1 each). There were 2 TR's attributed to operator error. Total down-time recorded during June was 5 hours.

Comparison of June data against prior year of operation shows that the June TR's are above the yearly average (27 against 21.9). A comparison of the one year operation regarding equipment types shows that the computer/terminals remain as a high source of trouble reports. This is associated with 3 computer and 6 terminal problems. The three computer problems were attributed to a power brownout condition. The UPS had recently been installed and was undergoing a start-up problem. The six terminal problems were associated with fuse blowing during brownout and cable damage that occurred during some modification work that took place in the hospital.

July Trouble Reports. Nature of the 22 July TR's were: Failure (9), Degradation (11), and Deficiencies (2). The 9 Failures were divided among the elements as follows: MHU (5), HSSCC (1), and QRS (3). The majority of the MHU and QRS failures required replacement, while the HSSCC failures required repair. The division between repair/replacement was 2/7.

The principal equipment types experiencing failures were: MHU equipment (3), QRS (2), computer/terminals, generator, camera/control, and wind-driven generator (1 each).

Only one of the July equipment failures out of nine resulted in operational down-time. The HSSCC IBM modem was down for four hours and required Varian service maintenance.

The 11 degradations were divided among the elements as follows: MHU (6), HSSCC (2) and QRS (3). The majority of the MHU, HSSCC, and QRS degradations required repair. The division between repair/replacement was 7/4. The principal equipment types experiencing degradations were: voice (3), generator (5), computer/terminals, video, and MHU vehicle (1 each).

In summary, during July, a total of 22 TRs were opened and 16 were closed. The 22 TRs were distributed among the elements as follows: MHU (12), HSSCC (3), and QRS (7).

The principal equipment types having trouble were: generator (6), MHU equipment and voice (3 each), computer/terminals, camera/control, QRS, and wind-driven generator (2 each), and MHU vehicle and video (1 each). Total down-time recorded during July was 4 hours.

Comparison of July data against prior year of operation shows that July TR's were slightly above the yearly average (22 compared to 21.9). A comparison of the one-year operation regarding equipment types shows a significant reduction in the computer/terminal problems (3) attributed to the reliable operation of the UPS. No other equipment type problem is large enough to be considered.

August Trouble Reports. Nature of the 18 August TR's were: Failures (9), Degradations (6), Deficiencies (1), and Modifications (2). The 9 failures were divided among the elements as follows: MHU (5), LHSC (1), HSSCC (2), and QRS (1). The majority of the MHU failures required repair, the HSSCC failures required repair, and the LHSC and QRS failures required replacement. The division between repair/replacement was 3/6.

The principal equipment types experiencing failures were: computer/terminal and MHU equipment (3 each), MHU vehicle, Voice, and QRS (1 each).

Two of the August equipment failures out of nine resulted in operational down-time. The HSSCC IBM modem was down for eight hours while the MHU had a flat tire delaying operations by two hours.

The 6 degradations covered in the MHU vehicle were corrected by repair. The principal equipment types experiencing degradation were: MHU vehicle (3), and the generator (3).

In summary, during August, a total of 18 TR's were opened and all were closed. The 18 TR's were distributed among the elements as follows: MHU (13), LHSC (2), HSSCC (2), and QRS (1). The principal equipment types having troubles were: MHU vehicle (8), computer/terminals and MHU equipment (3 each), generator, voice, camera/control and QRS (1 each). Total down-time recorded during August was 8 hours.

Comparison of August data against prior year of operation shows that the August TR's were slightly below the yearly average (18 compared to 21.9) and very close to the lowest failure months (Dec. 1975 and March 1976, with 14 failures).

The computer/terminal problems continued to show a significant decrease. The MHU vehicle had the majority of the problems (9). A major problem was associated with an air brake failure which caused an out-of-service period. This out-of-service period allowed extensive maintenance to be performed on the vehicle, of which three tasks were written up as trouble reports. The other two Trouble Reports were for flat tires.

September Trouble Reports. Nature of the 28 September TR's were: Failures (13), Degradation (13), Deficiency (1), and Modification (1). The 13 failures were divided among the elements as follows: MHU (5), LHSC (1), HSSCC (4) and QRS (3).

The MHU required repair/replacement while the HSSCC, LHSC, and QRS required repair. The division between repair/replacement was 9/4.

The principal equipment types experiencing failures were: generator (4), MHU equipment and voice (3 each), computer terminal (2) and Slow Scan (1).

Three of the September equipment failures out of thirteen resulted in operational down-time. The QRS generator was down for thirteen hours, however, during this period the standby generator was operated. The LHSC terminal was down for three hours and the HSSCC Slo-Scan was down for one hour.

The 13 Degradations were divided among the elements as follows: MHU (5), LHSC (5), HSSCC (2) and QRS (1). The MHU required repair/replacement, LHSC, HSSCC and QRS required repair only. The division between repair/replacement was 10/3.

The principal equipment types experiencing degradation were: voice (10), generator (2), and terminal (1).

In summary, during September, a total of 28 TR's were opened and 18 were closed. The 28 TR's were distributed among the elements as follows: MHU (11), LHSC (6), HSSCC (7), and QRS (4). The principal equipment types having troubles were: Voice (13), generator (6), terminals (3), and MHU equipment (6). Total down-time recorded in September was 17 hours.

Comparison of September data against prior year of operation shows that the September TR's were above the yearly average of 21.9. The multiple failures/degradation in the MUX radio and VHF units accounted for the increase.

October Trouble Reports. Nature of the 17 October TR's were: Failures (9), Degradation (7), and Modification (1). The 17 failures were divided among the elements as follows: MHU (4), and HSSCC (5). The MHU required 3 replacements and 1 repair, and HSSCC required 2 replacements and 3 repairs. The division between repair/replacement was 4/5. The principal equipment types experiencing failures were: Computer/terminal (5), MHU equipment (2), generator and camera/control (1 each).

Two of the October equipment failures out of nine resulted in operational down-time. The HSSCC Century Disc Drive was down for fourteen hours and the MHU Camera Control Unit was down for one hour.

The 7 degradations are divided among the elements as follows: MHU (4) and HSSCC (3). The MHU required 3 repairs and 1 replacement, while the HSSCC required 3 repairs, giving a division between repair/replacement of 6/1.

The principal equipment types experiencing degradation were: computer/terminal (3) and MHU equipment (4).

In summary, during October, a total of 17 TR's were opened and 8 were closed. The 17 TR's were distributed among the elements as follows: MHU (8), LHSC (1), and HSSCC (8). The principal equipment types having troubles were: computer/terminal (9), MHU equipment (6), generator and camera/control (1 each). Total down-time recorded in October was 15 hours.

Comparison of the October data against prior year of operation shows that the October TRs were below the yearly average of 21.9. The multiple failure caused by the computer head crash accounts for the majority of the TR's.